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Any one who has taken note of recent improvements in telephone apparatus will have observed that there is a tendency to make the apparatus at the subscriber's station more and more simple and automatic, and to relieve the subscriber of the necessity for doing anything except talking and listening. The widespread popularity of common battery systems has enabled a considerable simplification to be introduced at these stations, relieving them at once of both the station battery and the magneto calling apparatus. At one time, not so many years ago, the person using the telephone was under the necessity of turning the crank to establish communication with the central office, and also of making a disconnect signal when his conversation was finished; this latter, it may be remarked parenthetically, the subscriber generally neglected to do. The present systems have so simplified the subscriber's share of obtaining a telephone connection that all he has to do is to take his telephone down from the hook and talk; or, if his bell rings, take it down and listen. This is another step in the direction of that automatic perfection which has frequently been adverted to in these columns, and it is to be hoped that the public appreciate what has been done for them in relieving them of the magneto crank and the disconnect signal.

*ELECTRIC LIGHTING IN THE UNITED STATES.*

The history of electric lighting in the United States may fairly be said to begin in 1877 when arc lighting was first produced on a commercial scale from central stations. The real history of the art, however, certainly as regards its modern aspect, dates from the opening of the Pearl Street Station in New York city by Mr. T. A. Edison, on September 4, 1882. In the short space of nineteen years the industry has grown from the humble beginnings of that date to the magnificent achievement of to-day, when the investment represented by public service electric lighting plants in the United States alone amounts to nearly seven hundred million dollars and the industry is ranked as one of the most solid, secure and satisfactory that we have.

There has been nothing comparable to the growth of electrical industries in general in the whole history of civilization. Twenty-five years ago the fundamental engineering principles upon which this tremendous present development is founded were utterly unknown. At the Centennial Exposition electricity played a minor and inconsiderable part and hardly gave promise of becoming a commercial or industrial factor in any of its developments, except in the smaller arts of telegraphy and electroplating. At that exposition the electric light was for the first time exhibited in the United States. It would have been a bold man who dared to predict the extraordinary future of the electric light from the small beginnings that were then shown.

The history of public electric lighting is one in which those engaged in American industries should take just pride. At its inception the new illuminant was met by the powerful and organized competition of a long-established and successful industry—that of gas illumination. The fight was fought largely on its merits, the new companies being unable to enlist any investment comparable to that already put down in gas installations, while electricity had to make its way and win popularity in the face of as bitter and continued opposition as has ever been brought to bear upon any struggling industry. The actual merits of the new light, however, soon won for it at least respectful consideration, and constant improvements in apparatus and methods for its generation soon brought its price down to a point where its successful competition with gas was possible. Electric light companies began to pay dividends, a thing hitherto unheard of, and the industry was established upon a safe footing.

But, as in many other new commercial developments, a serious difficulty arose in the over-capitalization of companies formed to carry on the business of electric lighting. The thing was new, it was interesting, the light was incomparably better than any that had been seen before, and the speculative character of investments in electric lighting properties appealed to the considerable class of those having money to invest in "flyers." Innumerable companies were formed upon a basis which would hardly be considered respectable to-day, and the infant industry was dealt a blow in the house of its friends by this serious "watering" of its resources.

Not only was a difficulty put in the way of the development of the industry by this over-capitalizing, but the very fact that electric lighting was recognized from the outset to be a semi-public industry brought the promoters and organizers of the early companies into immediate contact with municipal councils, and paved the way for a certain amount of trading in franchises and rights which soon caused the investing public to look askance at the business management of electric lighting corporation in general. For many years the industry rested under the blighting influence of a popular disbelief in its sta-

bility. It is only in the last few years that it has taken its place in the popular mind as one of the established, steady, certain and remunerative industries in which money may safely be invested and fair returns may confidently be expected.

On other pages of this number will be found two articles of more than passing interest to all interested in the business of electric lighting. One of them is a carefully prepared tabular statement of the present status of the electric light industry in the United States. In this is shown, as accurately as conditions will permit, the number of plants in operation and the total capital invested, this information being tabulated by states. In another article is described, at great length and with an abundant wealth of illustration, one of the most interesting and successful electric light plants in the world, that at Providence, R. I. This installation may safely be said to represent what is typical of the very best American practice. Outside of its engineering features, which are attractive and which display extraordinary ability, perhaps the most interesting feature of this plant is the fact that it has continuously for some time past paid a dividend of eight per cent, while at the same time accumulating a comfortable surplus for extension and maintaining a sufficient sinking fund to cover depreciation. While it is of course evident that these facts indicate business management of the highest character at the head of this enterprise, they also show that electric lighting as an industry is one that deserves to rank with the safest and best paying of the various great directions of commercial endeavor, and it is hoped that a study of the methods employed at Providence will be of value, as well as of interest, to all those engaged in the electric lighting business.

Why not a shorter term for "Wireless Telegraphy"? It is not wireless, anyway, and the term is not only a misnomer, but it is far too long and cumbersome. Space telegraphy and wave telegraphy are open, also, to the latter objection. What is wanted is a short, concise word that will tell the whole story. The word should be one that adapts itself to international usage. Who can suggest it? There is really more than a little need for it.

### *WIRELESS TELEGRAPHY.*

The Naval Annual, issued a short time ago, presents a good idea of what the nations have been doing in the introduction and application of wireless telegraphy. This subject was assigned to Lieutenant L. R. Steigner, who has compiled many interesting facts regarding wireless telegraphy.

In the early development of wireless telegraphy, it was realized that its use would be largely confined to maritime and military purposes. One of the greatest disadvantages has been that the privacy of messages could not be secured. At present, however, Mr. Marconi claims to have succeeded in tuning his receiving instruments so that they will respond only to tuned transmitters.

Systems of wireless telegraphy have been and are now being installed on the war vessels of many nations. The steamships of several lines have also been equipped with installations of wireless telegraphy apparatus.

Chile is reported to have made contracts to have its naval stations equipped with the Marconi system. The right to terminate the concessions upon six months' notice is reserved.

Thirty-six ships of the British Navy have equipments of the Marconi apparatus, while ten or twelve more have Captain Jackson's apparatus on board. Numerous signal stations have been established on the shore of the English Channel and at other points along the coast.

The French have used the Popoff-Ducretet apparatus on the ships of the Mediterranean and northern squadrons and in the coast lighthouses. Great progress has been made in developing wireless telegraphy for use in the navy by Lieutenant Tissot and M. Rochefort, and they have succeeded in making many improvements.

The German Navy has adopted the Slaby-Arco system. Professor Slaby has worked with the object of giving the navy an efficient and reliable system, and one less expensive than that of Marconi. He appears to have solved the questions of syntonic and multiplex telegraphy and the results of his experiments have been very successful. Some of the ships have been supplied with these outfits, and many lighthouses have been equipped.

The Italian Government has been investigating the project of connecting its outlying islands with the mainland by means of the Marconi system, and thus doing away with submarine cables to them.

Japan has ordered outfits for some of her men-of-war. She has also been carrying on experiments on shore for the use of wireless telegraphy in the army.

The Russian Government has adopted the system of M. Popoff, who has been very successful in the development of the coherer. Many ships and stations on shore have been equipped. One of the Russian infantry regiments experimented with the Popoff system during field manœuvres and obtained very satisfactory results. The greatest drawback experienced was the weight of the apparatus. However, it was thought possible to make considerable improvements by the use of lighter materials.

Spain has devoted some attention to wireless telegraphy. Experiments are being carried on with a system invented by Colonel Cervera, of the Spanish Engineers.

The Swedish Admiralty is said to have contracted for four outfits of the Slaby-Arco system for shore stations and for apparatus for several vessels of the navy.

All the preceding goes to show that the governments of the leading nations of the world have not been slow to appreciate the many advantages presented by wireless telegraphy and that great progress in its development has been made.

From the present condition of the art it is reasonable to expect that equally great progress will be made in the near future. There are whisperings of great results achieved by the United States Weather Bureau, but these have not, as yet, been made public. So far, the actual commercial uses of wireless telegraphy have not been many, but the hope for its successful future is founded on apparently strong grounds.

### *ELECTRIC LIGHTING POLICIES.*

The question of the future policy of electric lighting companies is one of the deepest interest and greatest importance. Concerning it two of the ablest and most prominent men interested in the industry have contributed their views, which are here presented.

Mr. Thomas E. Murray, general manager of the New York Edison Company and an engineer who occupies a position of eminence, writes:

"In the field of electrical engineering as applied to the construction and operation of power-houses, the developments of at least the immediate future will tend largely to concentration of machinery at a single generating point favorable to that purpose, using alternating current for transmission and in congested industrial centres direct current for distribution.

"Centralization of production with an efficient system of transmission, permitting the location of distributing centres where needed, improves the station load factor and results in increased economy of operation and perfection of service. Complete concentration, particularly in a large system, may not be accomplished in a day, as there is much of the pioneer work of the past to discard, but economy will dictate that it should not long be deferred.

"With the advantages and conveniences offered by our large central stations, the practice of installing individual factory engines, private electrical plants, hydraulic elevators and other apparatus which requires the special maintenance of local steam installations, is rapidly becoming obsolete.

"The capacity of the electrical plant devoted to the individual building should be equal to the installation; and there should be a fair margin of reserve. Assuming, however, a capacity only equal to the installation the isolated plant requires more than three times the capacity required by the central station for an equivalent installation connected with its supplying mains. In some stations the ratio of generating capacity to installations connected is less than thirty per cent; the tendency is toward lower figures. The capacity of our largest station—the new Waterside station of the New York Edison Company—will be about 130,000 horse-power divided into units of 8,000 horse-power each. One single unit of that size is equal to eighty small plants each of 300 horse-power. This illustrates the possibilities of concentrated production.

"The prospective demand for electric current for both light and power is practically unlimited. As an advertising medium also, the electric light has many advantages which are receiving increased recognition. Signs, large and small, increased brilliancy of show windows and shops—brilliant beyond the necessity of mere illumination—attest this fact. Probably no one uses as much light as he would like. Here and there a store or dwelling may be well lighted, but the general tendency is to exercise economy. There is a continued demand for a more efficient lamp for incandescent lighting, with good prospects for substantial improvement. The Nernst lamp, in economy and quality, is full of promise. Incandescent lamps, with filaments similar in shape to the carbon filament but of different materials or coated by them, such as the osmium lamp, afford a direction along which improvement is probable.

"Any lamp which will enable more and better light to be produced without material increase of cost, would be a great benefit alike to the customer and the supplying companies. It does not necessarily follow that their revenues will be reduced. Users become accustomed to a certain expenditure and usually prefer to take advantage of reductions in price by using more light in preference to reducing bills. No method of supplying power for mechanical purposes has been found so successful, convenient or cheap as the electric motor supplied from a central station; the electric elevator giving perfect access to all parts of the building and the small shop motor increasing manufacturing facilities and reducing physical effort of employés are examples. An electric elevator completes the equipment of a new building and modernizes an old one; the shop motor relieves the workman of physical effort, enabling him to centre his attention to improvement of production in quality as well as quantity. Instances recur in which an electric motor, costing less in operation than the wages of one unskilled workman, has increased the manufacturing capacity of a fair sized concern threefold.

"The supply of light and power will doubtless continue to be the most important and remunerative features of central station service. Electric heating on a large scale is too expensive for general use, but there are a number of convenient small heating appliances which can be used advantageously and with the entire elimination of the fire hazard. While bringing but little revenue, the use of these conveniences often leads to larger developments."

Referring to the same problems, Mr. Louis A. Ferguson, general superintendent of the Chicago Edison Company and president of the Association of Edison Illuminating Companies, writes:

"In regard to the changes in the methods of handling electric light stations' output, it seems to me that the policy of all large companies will be to follow the lines that have been laid down within the last three or four years advocating the abandonment of multiplicity of generating stations in the large cities and the centralization of the power in one or two large plants located where sufficient water for condensing purposes may be had and adjacent to main lines of one or more coal railroads. This will undoubtedly necessitate the location of the station being away from the centre of distribution. The power-house will then generate three-phase alternating current at a pressure of 6,000 volts or more, transmitting the current to substations conveniently located around the city where the current will be converted into direct current for the densely populated sections, and in the scattered suburban districts to alternating current of the proper frequency for general distribution.

"The only way to meet the opposition of other illuminants is to follow a liberal policy in the extension of the company's system, and to branch out into all sections that will within a reasonable number of years show a fair return on the investment. Electricity has driven gas practically out of the business sections of large cities and is hardly to be considered a competitor in that portion of the city, but in the residence and outlying districts it will be necessary for the electric lighting companies, in order to increase their business to any large extent and cover the same field as is covered by the gas companies, to find a more economical lamp than is at present on the market. The success, therefore, of high-economy lamps, such as the Nernst lamp, is most devoutly wished for by the electric companies, for with it the electric companies will be able to meet the gas companies in the outlying sections as well as in the densely populated portion of the cities.

"In several of the large cities central station companies have been very successful in preventing the installation of isolated plants, and also in removing isolated plants which have been in operation for some time. This can only be done by the most vigorous investigation of the true expenses of the operation of the isolated plants and showing to the prospective purchaser of isolated plants the necessity for including in his estimate of expenses the matters of interest and depreciation on a conservative basis. To meet this competition it is also necessary to make what might be considered by some very low prices, but it is the policy which will ultimately bring success to the central station companies and lessen the danger of competition, as isolated plants, when once installed, are liable to grow in a short time to become embryo central stations.

"In small cities, and possibly in the suburban districts of large cities, the utilization of the exhaust steam from non-condensing plants for the purpose of heating water for general circulation in the residence district for heating purposes will increase the income of central stations without any material increase in cost, provided the extensions of the mains are conservatively made.

"Central stations should be laid out wherever possible so as to generate only one class of output and to avoid the policy which has been pursued in the past of installing three or four different systems for as many different classes of service.

"The development of the series alternating arc lamp will greatly benefit central station companies, and there is at the present time a strong demand for thoroughly efficient and successfully operated series alternating arc lamp systems for 100 lamps or more to be operated directly from the main generator in large alternating-current stations.

"I do not feel alarmed about the reduction of income by the use of the extremely high-economy lamps, which I have mentioned before, for the reason that with their advent will come an enormous increase in the companies' output which certainly ought to more than compensate any loss of income from existing customers. With the consumption of energy per candle-power reduced to one-half or one-third of what it is at present the lighting companies, with proper rates, should be able to put the gas companies to rout in almost any territory."

These two communications speak for themselves, and require no comment. They are the utterances of men who thoroughly know their ground, and they are both marked by an encouraging suggestiveness. The electric lighting industry was never on a better basis, and it never had a brighter future than it now enjoys.

### *THE BUREAU OF STANDARDS.*

It is hoped that in a short time the new Bureau of Standards, at Washington, will be in full operation and ready to render its almost invaluable aid to the technical manufacturing industries of this country. It is urgent, however, that a campaign of education be conducted in connection with the bureau itself, so that the general mass of people may understand its importance and avail themselves of its benefits. Perhaps much of the success of that superb institution, the Reichsanstalt, has been due to the way in which German manufacturers have used it. It is little less than a national reproach that we should have been compelled to send to Germany for manufacturing standards for use in electrical work in the United States, and it is greatly to the credit of the German Government that we were able to obtain them there. But this condition of things will soon be removed and our own national Bureau of Standards will be able to supply what can only be called a long-felt want.

# Science Brevities

**The Stassano Electrometallurgical Process**—This process aims at replacing the heat of combustion of the coal in the ordinary metallurgy of iron by the electric arc, and should be particularly advantageous in countries where fuel is costly and water power cheap. It is described by E. Fumero in *L'Elettricità* and abstracted in a British magazine. The roasted and powdered ore is first of all passed through a magnetic separator in order to prepare a material rich in iron. This is then analyzed, and the amount of carbon required for its reduction calculated. The mineral is then mixed with the necessary amount of powdered wood charcoal and tar, whose percentage of carbon is known, and a slag-forming material, and made into briquettes. These are then introduced into the electric furnace. The chemical reaction is at first very lively, but becomes quieter after a time, and the amount of heat necessary continually decreases. A furnace of 150 horse-power yields in one and one-half to one and three-quarter hours nearly thirty kilogrammes of wrought iron. By varying the amount of carbon added according to the previously made analysis, it is possible to prepare a cast iron with a certain fixed percentage of carbon. The author calculates the cost of the power necessary, and also of the iron obtained per ton, and comes to the result that the method is particularly applicable where water power is to be had. The plant at present working is at Darfo (province of Brescia), and uses a fall of thirty metres and five cubic metres water per second.

**Mathematical Investigation of the Interior Tensions of a Polarized Fluid**—Maxwell's theory, which attributes electric and magnetic phenomena to tensions and pressures in the medium that forms the seat of electric and magnetic energy, has long been a subject for criticism. In the *Nuovo Cimento*, Signor Luigi Giuganino now advances certain considerations arising from a mathematical investigation of the tensions in the interior of a fluid polarized magnetically or dielectrically. This article is abstracted in *Nature*. The author finds, among other results, that if the polarized body is compressible and behaves like a fluid body, and only carries induced charges, it is impossible to find a system of elastic stresses equivalent to the given polarization. If, however, the polarized body is considered to be an imperfect fluid, either there exist an infinite number of systems of tensions and pressures equivalent to the polarization, or no such system exists. The expression for these tensions and pressures does not, however, reduce to Maxwell's and Helmholtz's formula. Signor Giuganino further advances the view that the elastic constant of the fluid when polarized assumes different values along and perpendicular to the lines of force, and that herein lies the explanation of Kerr's phenomenon.

**Automatic Field Regulator**—In a recent paper published on the Continent, which is digested in a British contemporary, Mr. B. Krausse describes an automatic field regulator for shunt-wound dynamos. The arrangement consists of a toothed wheel connected to the switch arm of the regulating rheostat, and over this wheel are arranged two oppositely turned feed pawls mounted below a balance beam at equal distances from and on opposite sides of the fulcrum, the balance beam bearing detents for locking the feed pawls, so that when the balance beam is horizontal both pawls will be held out of engagement with the toothed wheel. The balance beam is actuated by the damped core of a solenoid connected, for example, as a shunt to the dynamo terminals, so that, when the core sinks, one pawl will be released and will engage with the toothed wheel, and when the core rises, the other pole will be released and engaged with the toothed wheel. Between the feed pawls, which are drawn together by a spiral spring, a lever oscillates, driven by a connecting rod and crank from a small flywheel and having a projection for alternately tripping a second pair of detent levers, also holding the feed pawls. By this means, when the pressure rises, one pawl will be released, and will swing into contact with and be actuated by the oscillating lever so as to turn the toothed wheel and rheostat arm in one direction, and when the pressure falls the rheostat arm will be turned in the other direction in a similar manner by the other pawl.

**Distribution of Potential in Short-Circuited Three-Phase Generators**—In *Science Abstracts* a valuable paper on this subject by Mr. E. Rosenberg is abstracted as follows: When a single-phase alternator is short-circuited, the electro-motive force in any section of the armature winding is balanced by the fall of potential along the same section. In the case of star-connected three-phase generators, this statement does not hold good. Experiment shows that there may then be a considerable potential difference between the neutral point of the winding and the short-circuiting conductor, and that if these two be connected by a stout conductor (an ammeter being included in the circuit), a considerable current will flow through this conductor. Curves obtained with several different machines are given which exhibit this effect very clearly. The explanation is to be found in the presence of a third harmonic in the electro-motive-force wave. The author describes a number of experiments, all of which go to prove the fact that the frequency of the current obtained in the conductor connecting the neutral point with the short-circuiting conductor is three times the frequency of the current in each phase. A detailed graphical discussion of the effect is given. In the directions issued to fitters it is frequently stated that when running the machine on short-circuit, in order to heat up the coils before a test under load, the rise in temperature may be estimated by placing the hand in contact with the coil, and that there is no danger in doing this. The author points out that in the case of many three-phase machines such a procedure might be attended with danger to life.

**Effect of Illumination Upon Metallic Surfaces**—When a metallic plate is illuminated by ultra-violet light it easily loses a negative charge, but this loss is not maintained at the same rate on prolonging the illumination while maintaining the potential. The discharging power of the ultra-violet rays seems to exhaust itself. After a prolonged exposure the plate is no longer sensitive, and requires keeping in the dark for some time before showing any photo-electric effect; or the action can be restored by renewing the surface, as is done easily in the case of amalgamated zinc by simply wiping it. M. Buisson, who has paid special attention to this matter, notices that it is connected with other physical properties of metals, notably the difference of potential established on contact. The results of M. Buisson's work have been published in the *Journal de Physique* and abstracted by the London *Electrician*. The illuminated metal becomes more strongly negative. But, again, this modification is not permanent, and it rapidly disappears in the dark. The effect is independent of the gas surrounding the metals. Various photographic facts also show analogies, notably the fact that an exposed plate can not be developed after long storage in the dark. The modification of metallic surfaces only affects an extremely thin surface layer, and exerts no influence upon optical polarization. It is due, according to the author's opinion, to condensed or occluded gas or vapor.

# The Narragansett Electric Lighting Company's System.

**A Description of the Great Installation which Lights and Furnishes Motive Power for Half of the State of Rhode Island.**

THE STATE of Rhode Island consists of an irregular rectangle and an extension, formed by a group of islands and a peninsula, divided from the main body of the state by the waters of the Narragansett Bay. At the head of this bay and on the western side of it is situated the city of Providence, having a population of approximately 200,000 people and forming the centre of a group of towns and villages comprising a total population of about 300,000. In the city of Providence, on the water-front and at a point conveniently situated with reference to the reception of supplies and nearness to the centre of the business district, is located the central station of the Narragansett Electric Lighting Company, from which is supplied the major part of the lighting and motive power for the northern half of the state of Rhode Island. Comprising as it does both alternating and direct-current systems of supply, and having the largest installation of high-voltage multiple lamps in the world in operation, this fine installation possesses extraordinary interest on many accounts. While the company was one of the first in the field of electric lighting in the United States its equipment to-day is one of the most modern, and its methods of operation are such as to deserve extended description and to enlist deep interest.

FIG. 1.—A PORTION OF THE MAIN ENGINE ROOM OF THE NARRAGANSETT ELECTRIC LIGHTING COMPANY'S STATION.

The lighting district covered by the mains from this installation and its substations comprises an area of somewhat over 300 square miles. In general the method of distribution adopted is a three-wire, direct-current system for the portion of the city of Providence known as the Fire District, which is an irregular rectangle about six square miles in area; outside of this district single-phase alternating current is distributed for lighting and small motors. In the Fire District there is also a two-wire, 500-volt motor circuit, while a three-phase installation is now being installed for the distribution of power to the company's substations. The lighting network in the city proper is fed from a storage battery substation, while all of the power used is generated in the single water-front station in South street.

### THE GENERATING STATION.

The generating station consists of a group of buildings situated on the immediate water-front of the city and containing, besides the apparatus for the generation of electric energy, the workshops, station offices, engineering and drafting rooms and supply-storage departments of the company. Steam is generated by a battery of twelve Babcock & Wilcox water-tube boilers, of which six are of 400-horse-power and six of 250-horse-power rating. The city water, which is remarkably free from sediment and troublesome salts, is used for feed water, and a mixture of equal parts of West Virginia coal and anthracite dust is used as fuel. Firing is done

by hand and 160 pounds pressure is carried normally. The feed pumps are of the Worthington outside-packed plunger pattern. Exhaust from the air pumps is received in a heater of the "Gleaner" pattern, made by I. B. Davis, of Hartford, Ct., and the water passing through this

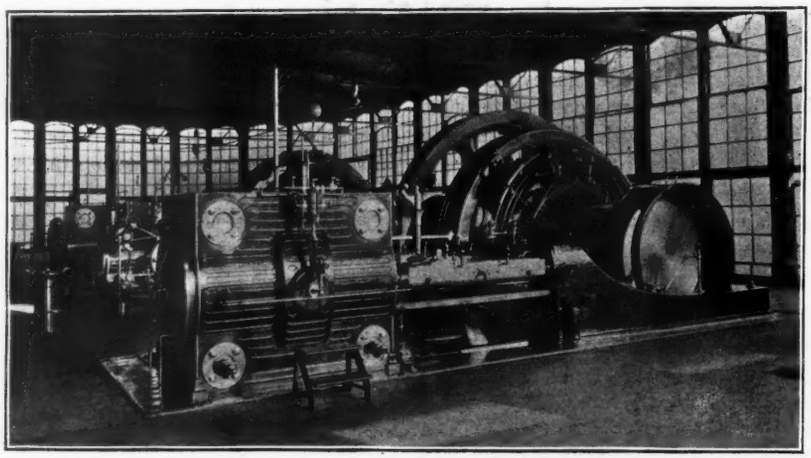

Fig. 2.—Two of the 550-Volt Direct-Current Units.

is heated almost to the boiling temperature before entering the Green economizer through which it passes on its way to the boilers. This economizer is provided with an electric motor drive.

The smoke header for the various boilers consists of an underground brick flue and communicates with the base of a brick stack 260 feet high and having an internal flue diameter of 14 feet. The stack has a wide space between its inner and outer shells and in this space is constructed the ladder which gives access to its top.

All of the piping in the boiler room is of lap-welded steel, having welded flanges with rabbeted joints and cast-steel fittings.

In all ten main engines are supplied with steam from this boiler plant. The engines are all of a horizontal cross-compound Corliss type and, though constructed by different makers, follow a general standard design. Of these engines four of 750 horse-power each were constructed by the International Power Company, of Providence; three of the same power and two of 1,500 horse-power each by the Edw. P. Allis Company, of Milwaukee, Wis., and one of 1,800 horse-power by the Rice & Sargent Engine Company, of Providence, R. I. The engines are equipped with Rites inertia governors, made under arrangement with the inventor by the Narragansett company itself, this station having been the first in which this type of governor was applied to Corliss engines. Each engine is equipped with a Monarch safety engine stop, which operates in case the engine passes its proper limit of speed, shutting off steam at the throttle valve.

The seven smaller engines are fitted with direct-coupled air-pumps, while for the larger engine Blake twin independent vertical air-pumps are provided. The whole plant is operated condensing, the harbor water being used for this purpose. A gravity-feed oil system is used throughout the station, the oil being pumped to an overhead reservoir by a triple-throw pump direct-coupled to a small electric motor. Very high economy in oil consumption has been attained by this means.

The steam plant as it stands is one of high efficiency and reflects much credit upon its designer.

Three of the 750-horse-power engines are direct-coupled to General Electric 500-volt, direct-current generators. The two 1,500-horse-power engines are belted through a countershaft to arc generators. The 1,800-horse-power engine is direct-coupled to a Westinghouse three-phase, 60-cycle, 2,200-volt generator, while three of the 750-horse-power engines are direct-coupled with single-phase revolving armature machines. Of these one is of General Electric make and two are of Westinghouse make, the first two of them installed having been the first machines of this type made in the United States. The type is that known as the flywheel alternator, in which the armature coils are car-

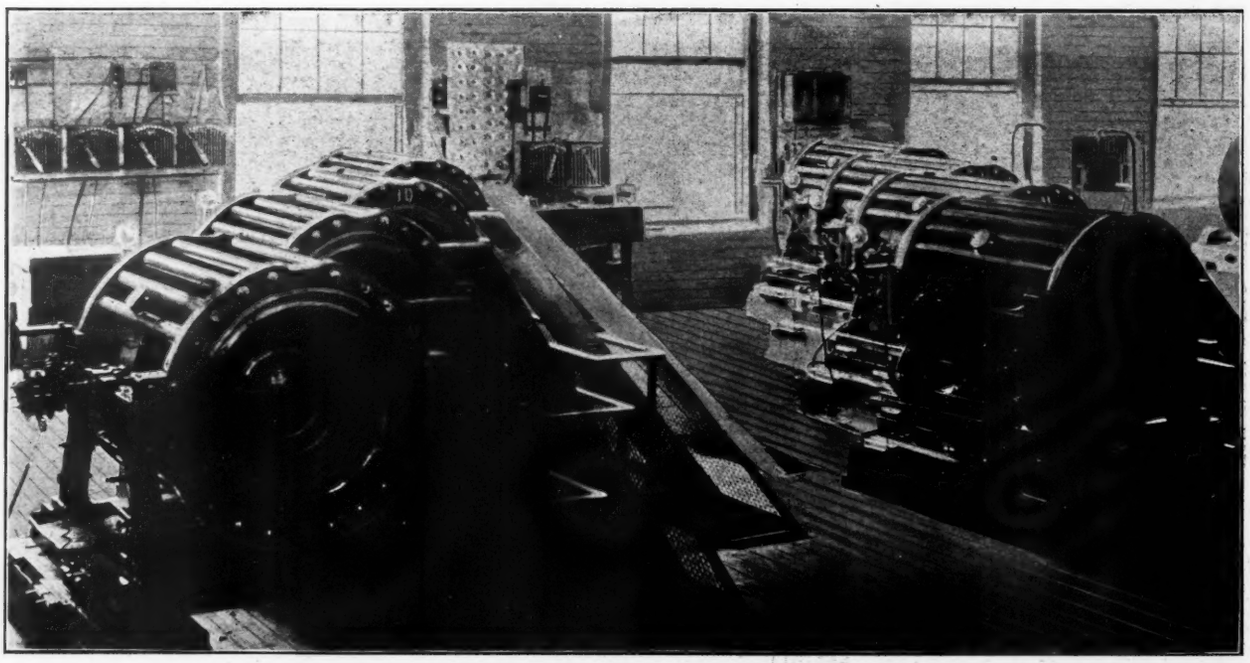

Fig. 3.—Group of T.-H. Machines Converted to Alternators for Series Incandescent Street Lighting.

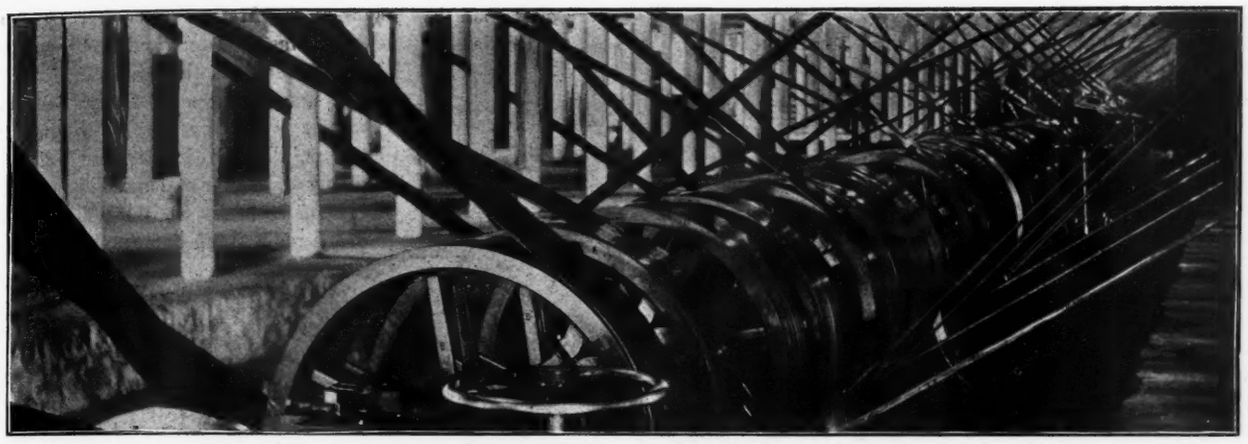

FIG. 4.—THE COUNTERSHAFT UNDER THE ARC DYNAMO ROOM, NARRAGANSETT STATION.

ried on the face of the revolving element and turn inside a stationary field ring.

The arc light machines, of which a considerable number are used for series incandescent street lighting, are grouped in a room to themselves (which also contains the main switchboard) and comprise eighteen "Wood" 125-lighters and eighteen ring-armature Thomson-Houston machines, each of 50 lights capacity. The Thomson-Houston machines are used exclusively for the incandescent street lighting and several of them have been changed in a highly ingenious way to alternators of output considerably greater than they originally possessed as direct-current machines.

The series incandescent street lighting supplied from this station is done by lamps taking 6.6 amperes and provided with automatic film cutouts. Their filaments are comparatively coarse and it was therefore thought that they would exhibit no perceptible flicker, even at a very low frequency, if supplied with alternating current. The experiment was made of dividing the three-part winding on the armature of the Thomson-Houston machine and leading out its terminals to collecting rings from which a current of 16 cycles per second was withdrawn. Regulation is accomplished, of course, by the field excitation, which is automatically governed. The experiment was entirely successful and it was found that the machines could be carried to a considerably higher capacity than they had as originally designed. Each of these machines is provided with a spark discharge-gap across its armature circuit to take care of the sudden rise in voltage, sometimes following open-circuiting a line.

The switchboard, which is situated in the arc lighting room, is made in two stories and is mounted on a white mar-

FIG. 5.—LARGE SINGLE-PHASE ALTERNATORS IN THE NARRAGANSETT COMPANY'S STATION.

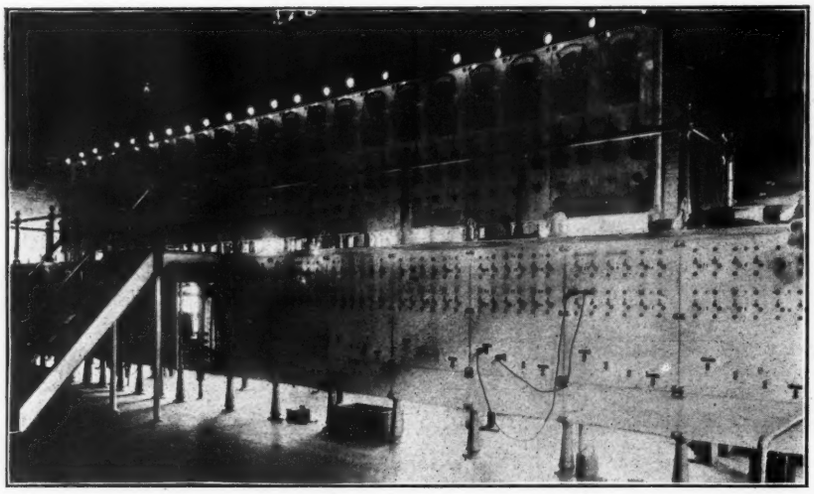

FIG. 6.—ARC CIRCUIT PLUGS ON THE MAIN SWITCHBOARD.

bars at the station, a booster having a capacity of 100 volts and 1,500 amperes being included in this circuit. The 500-volt system of mains and feeders for power purposes is directly coupled to the same bus-bars, thus uniting at that point the lighting and power systems. The arrangement of end-cells and switches in the battery room is of the usual type, these switches being operated by motors controlled from the front of th distributing switchboard at the substation. The accompanying illustrations exhibit the interior of the battery room and these switches. To this battery distribution is connected the equivalent of 60,000 incandescent lamps of sixteen candle-power. A considerable use is made in Providence of eight-candle-power and small decorative

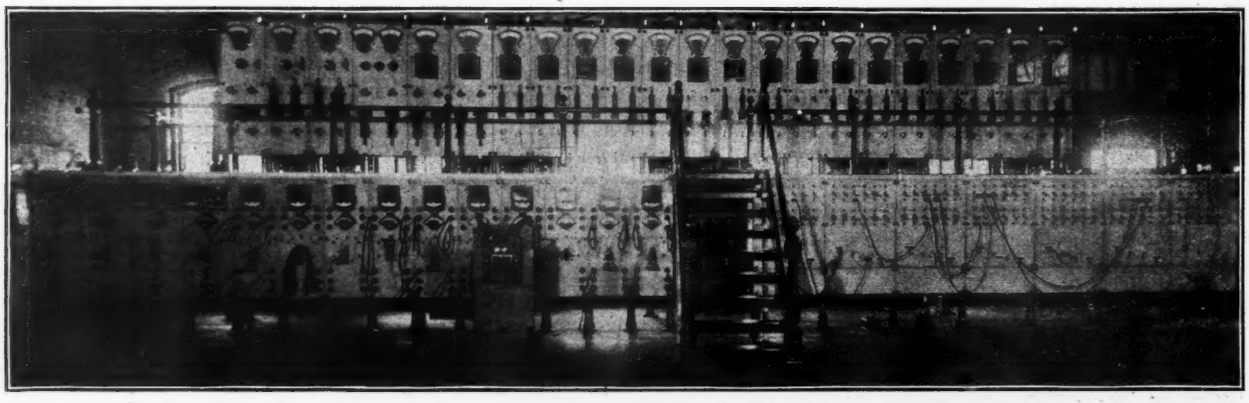

FIG. 7.—THE MAIN SWITCHBOARD IN THE NARRAGANSETT STATION.

ble base. This board is of the simplest character, the larger part of the direct-current output of the station going to the storage battery substation about half a mile away. For the arc circuits Weston voltmeters are provided, while the remainder of the board is fitted with General Electric instruments and switches. The cables for the outgoing circuits of all kinds descend from this board into a vault, 55 by 9 feet in area and 12 feet deep, whence they go out in the conduits to the substation for distribution.

THE STORAGE BATTERY SUBSTATION.

The storage battery station is situated near the business centre of Providence, 2,400 feet from the main station switchboard, and consists of 292 cells of chloride type, each having a normal charge rate of 840 amperes.

To understand better the system of distribution through this station reference will be made to the accompanying diagram which shows roughly the general plan of current supply. Incandescent lighting, in the Fire District, is accomplished by direct-current 235-volt lamps, burning on a three-wire system having 470 volts between the outside wires. The battery is fed directly from the 550-volt bus-

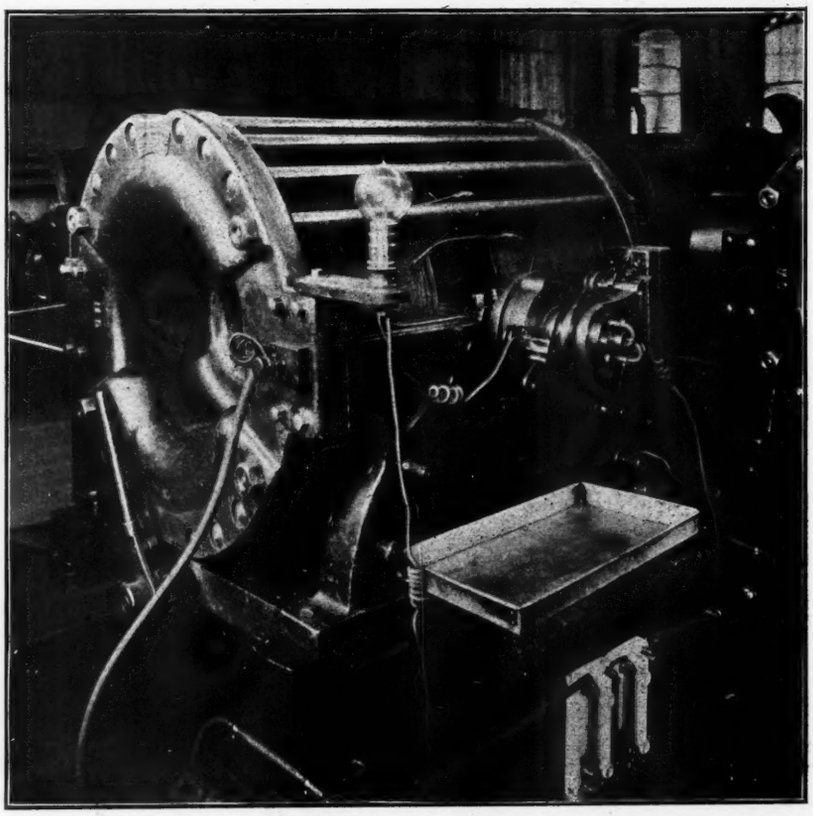

FIG. 8.—COLLECTOR RINGS ON CONVERTED T.-H. ARC MACHINE.

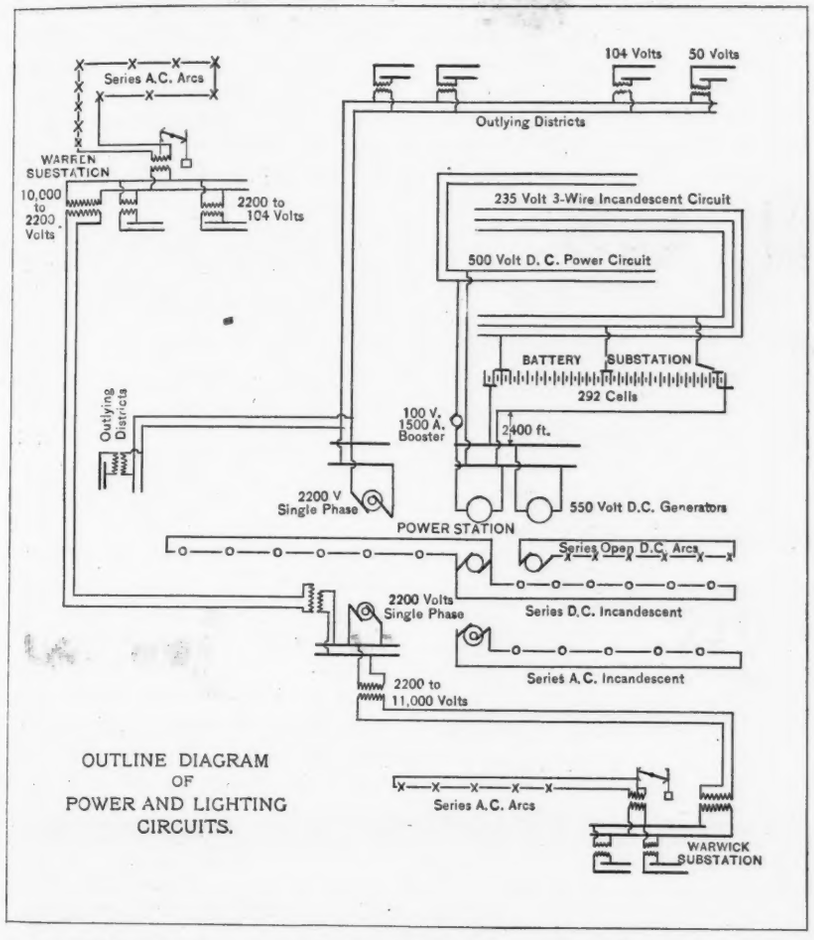


FIG. 9.—SKETCH DIAGRAM OF THE NARRAGANSETT COMPANY'S DISTRIBUTION SYSTEM.

lamps. No motor of more than one-half horse-power is connected with the three-wire lighting mains. Larger motors are operated from the 500-volt power circuit or, if they are located in the suburban districts, by single-phase alternating current. This will eventually be changed to three-phase when the installation now under erection is completed.

LIGHTING AND MOTOR SERVICE IN PROVIDENCE.

As stated in the foregoing, lighting in the city of Providence proper is confined to direct-current open arcs, direct and alternating series incandescent street lights, private arc lamps burning on the 235-volt battery circuit, and incandescent lighting also fed from the latter source of supply. In all, in the city and outlying districts, there were connected on October 1, 1901, 845 enclosed arc lamps on constant-potential circuits, 2,065 open arcs on series service, 55,958 incandescent lamps fed from the battery mains, 73,828 lamps fed from the single-phase alternating current at 50 and 104 volts in the outlying districts, 3,518 35-candle-power series street lamps, 412 multiple arc lamps on alternating current and 126 constant-current alternating enclosed arc lamps fed from constant-current transformers of the General Electric pattern installed in substations. The motor service was as follows:

| | | |
|---|---|---|
| Alternating.....19 motors | 178 | horse-power. |
| Direct, 235 volts..... 33 " | 45 | " |
| Direct, 500 volts.....729 " | 4,400 | " |
| Total..... .....781 motors | 4,623 | horse-power. |

An interesting type of lamp has been developed by the company for use in connection with the 235-volt battery circuit for private consumers. It consists of a double arc lamp of the enclosed type in which two arcs are maintained between two pairs of carbons. These arcs are in series with one another and the control mechanism. Each is independently operated by its own clutch and regulating devices. The total over-all efficiency of this type of lamp is claimed to be as good as that of any enclosed arc lamp burning on 125-volt circuits, while the illumination obtained is remarkably good and well distributed. Large numbers of these lamps are in use in stores and elsewhere by private consumers.

The arc street lighting circuits are patrolled four times nightly by watchmen on the lookout for lamps out. The incandescent street lighting circuits are also patrolled and immediate reports are made whenever a circuit is discovered in trouble or a lamp burning badly.

It is interesting to note in this connection that the service has been interrupted only once (for one hour) in the last seven years. In nineteen months past there has been only one short-circuit on the battery system, which lasted nine minutes and resulted only in putting out of service one comparatively small circuit of lights.

FIG. 10.—THE ARC DYNAMO ROOM IN THE NARRAGANSETT STATION.

THE UNDERGROUND DISTRIBUTION SYSTEM.

Perhaps nowhere has a more elaborate and carefully worked out system of underground installation been laid than in Providence. The business centre of the city is situated at a very small elevation above high-tide level, and in some parts of the city, where underground circuits were absolutely necessary, the conduits are actually below the water level of Narragansett Bay. Under these circumstances conditions of the utmost difficulty were introduced into the work and its successful accomplishment in the face of them is a subject for general congratulation.

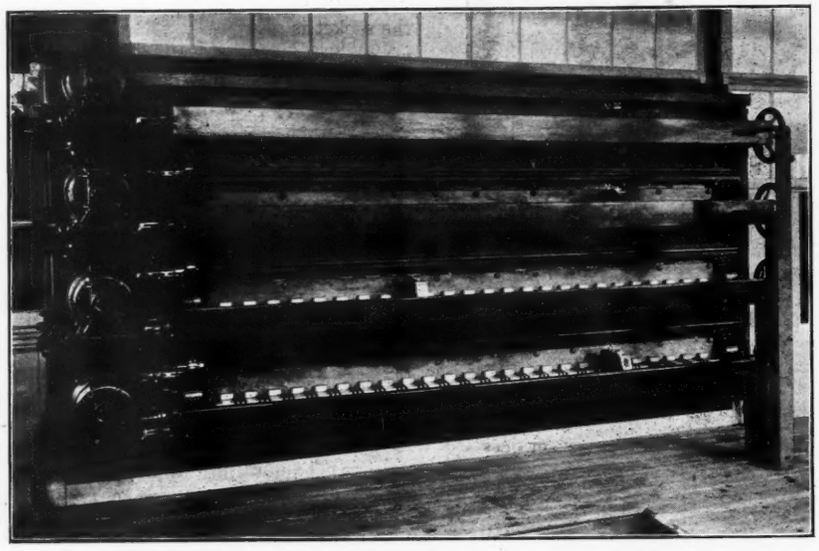

FIG. 11.—THE ELECTRICALLY CONTROLLED END-CELL SWITCHES IN THE STORAGE BATTERY SUBSTATION.

In all, about forty miles of street were opened for conduit, and in this was laid 1,700,000 feet of vitrified clay duct. Of this amount 700,000 feet are in multiple duct, while a million feet are of the self-centring pattern of single duct. All of the terra-cotta was made by the American Vitrified Conduit Company, New York.

Upon this extensive system of conduits there are located 850 manholes, the standard size of these being 7 by 7 feet square and 8 feet deep. The largest manhole, which is situated just in front of the battery substation, is 21 feet long, 8½ feet wide and 9 feet deep. The illustrations give a good idea of the method which was used in water-proofing these manholes and conduits where they were laid below the possible high-tide level. The general method consisted in building a twelve-inch brick wall to form the exterior of the conduit, the floor being reenforced by steel rails where it was liable to be subjected to the upward pressure of surrounding water. Upon this brick wall was laid a serving of heavy five-ply tar paper, put on with hot asphalt, and inside this several inches of concrete were plastered. The ordinary type of manhole, where this water-proofing is not necessary, has shelves made by laying alternating courses of brick with ends protruding inward for the reception of the cables. At every junction in the manholes and at cross-over points fuses of large capacity are introduced, the idea being to localize trouble due to a short-circuit should one occur in the immediate neighborhood of the accident. Fuses up to a capacity of 500 amperes at 500 volts are employed, these, like all the other fuses in this entire system, being of the D. & W. enclosed type. The large fuses are made of aluminum encased in a non-silicious insulating powder contained in a fibre tube and having an air-gap in the middle. Smaller fuses make use of composition metal of low fusing point. The greatest success has attended the installation of this variety of protection and no serious trouble has been encountered in the operation of any of the lines in the underground system since its erection. It should not be forgotten in this connection that the smallest difference of potential employed between conductors in these conduits is 235 volts.

FIG. 12.—METHOD OF BUILDING BRICK CABLE SHELVES IN STREET MANHOLES.

The cables are of the lead-encased type throughout, stranded where the size is larger than No. 6 B. & S. gauge, and were made by the Okonite Company, in New York. A rigid specification for insulation has been insisted upon and the thickness of insulation employed is perhaps unusual. At any rate, the results obtained have fully warranted the practice adopted by the company's engineers in using heavy insulation, as cable trouble has been entirely absent since the construction of the conduits. The company's standards for insulation thickness are as follows:

For arc lighting, $\frac{7}{32}$ inch; for low tension work (this includes everything, 500 volts down), $\frac{5}{32}$; 2,000 to 6,000 volts, direct or alternating, $\frac{7}{32}$ inch; 11,000 volts alternating, which is employed on the transmission line to the substations, $\frac{9}{32}$ inch.

Of the latter variety of line there are four miles underground and 800 feet of Okonite submarine cable is used on the 11,000-volt line in crossing the Seekonk River. Other submarine cables cross the

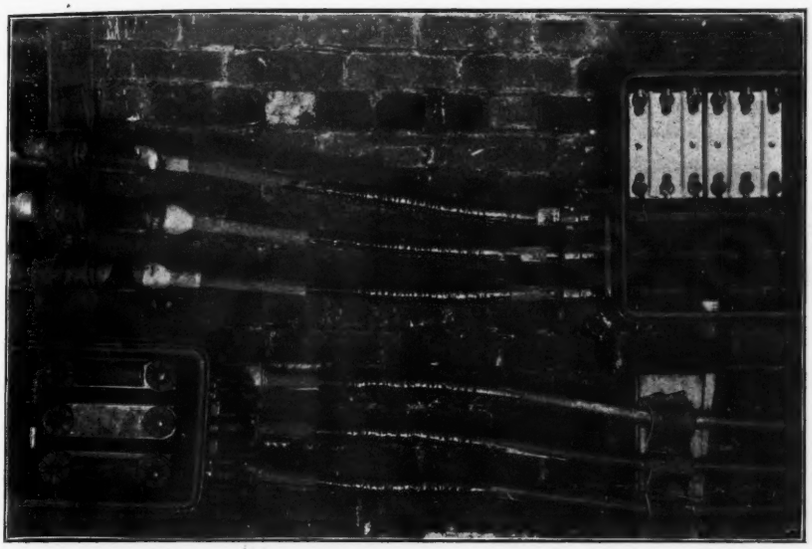

FIG. 13.—SERVICE DISTRIBUTION BOXES IN A STREET MANHOLE.

harbor to East Providence, these conveying the battery circuit. They are also of the same insulation, lead sheathed and armored.

STREET LIGHTING.

Street lighting in the district covered by the company's circuits is of three kinds: Direct-current, open arc lighting in Providence and the immediate neighborhood, series alternating, constant-current, enclosed arc lighting in outlying districts fed from substations and series incandescent lighting over a large part of the total district. The figures for the various kinds of lamps employed in these services are given above.

The standard fixture for the incandescent series lighting consists of a wrought-iron bracket about five feet long, of ornamental design, carrying a glazed metal reflector and a shield for the socket in which the lamp is placed. The lamps used are of General Electric Company's make, giving 35 candle-power when burned on 6.6-ampere current. The lamp is made with long copper terminals carrying between them the film cutout and arranged to be thrust into a porcelain receptacle having engaging strips which bind the copper terminals and complete the circuit through the lamp. The base of the lamp is made of porcelain of high insulation and all of the socket is concealed within the reflector where it is entirely protected from moisture and t e weather. The film cutout consists of a small piece of very thin silk tissue which separates the lamp terminals from one another. The fall of potential through the lamp is only about 22 volts, for which the silk film is a sufficient insulation. Should, however, the lamp filament be ruptured, the whole potential of the circuit accumulates on the two sides of the film, instantly rupturing it, and closing the circuit past the lamp, which is thus effectually cut out. These incandescent street lights are burned under a contract calling for a maintenance of 32 candle-power. The lamps are of 35 candle-power and work at a normal efficiency of 4 watts. When their output has fallen to a little above 32 candle-power they are renewed. The general results obtained with this variety of street lighting have been highly satisfactory, and it is noteworthy that despite strenuous efforts to introduce Welsbach street lamps the in-

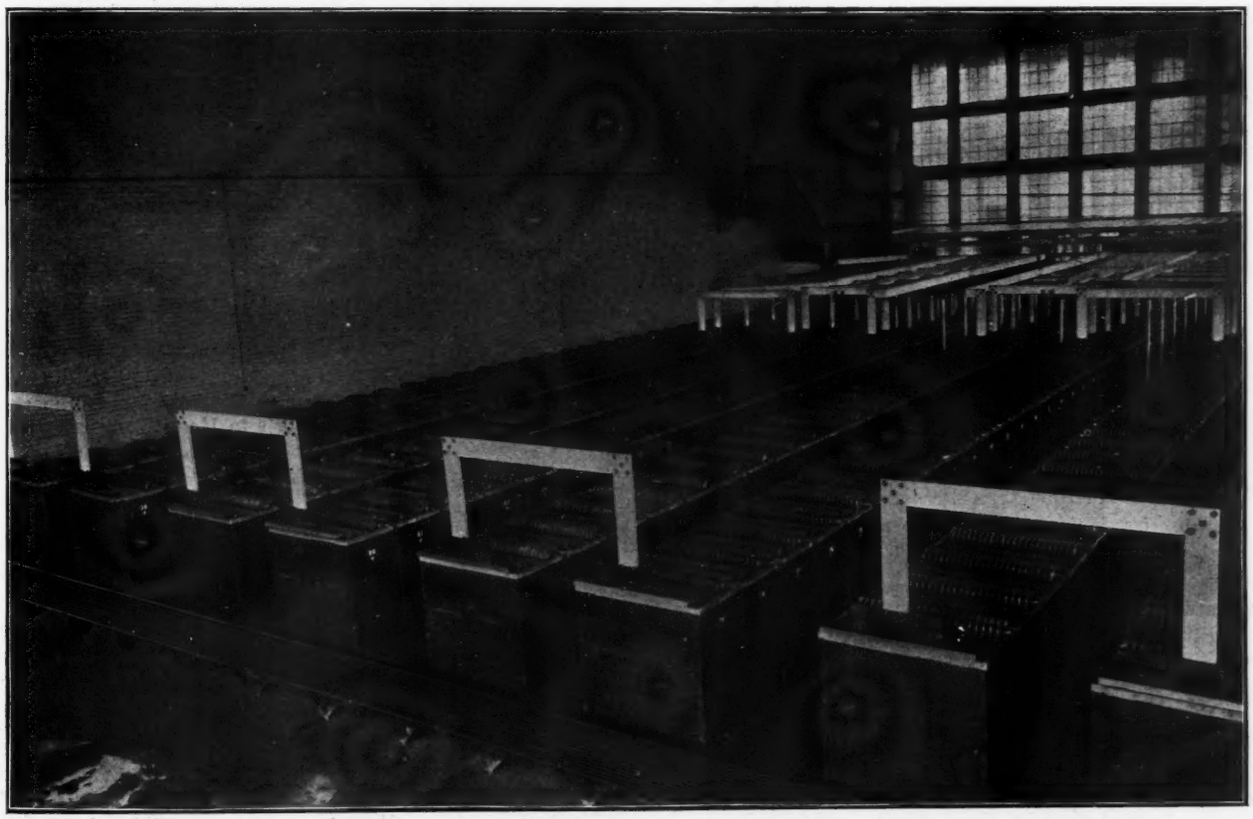

FIG. 14.—THE BATTERY ROOM IN THE STORAGE BATTERY SUBSTATION. END-CELL CONNECTIONS IN BACKGROUND.

candescent lamps have held their own and maintained their popularity with the public.

The open arc lighting in Providence proper is done by double-carbon lamps hung from mast-arms approximately over the street intersections. Arc lighting in the suburban neighborhoods surrounding the substations is done by alternating-current enclosed lamps burning in series, and these have given excellent satisfaction.

THE OUTLYING DISTRICTS.

No less than ten towns in the vicinity of Providence are embraced in the general lighting distribution of the Narragansett company. The majority of this lighting is fed directly from the South street station by alternating-current lines having 2,200-2,000 volts in the primary system and 50 or 104 volts on the secondary. The total number of lamps connected on this network is equivalent of 73,828 16-candle-power lamps. In connection with this general distribution there are two substations, located respectively at Warren and Warwick. Each of these is about ten miles from the power station and is supplied at present by a single-phase circuit working at 11,000 volts. The Warren line goes for two miles from the station in lead-covered cable in the conduit, then for 800 feet under the Seekonk River in submarine cables and for about eight miles on poles. For the overhead line weather-proof insulation is used, with high-test, deep-groove insulators, which are carefully tested before being placed in position on the line. The line to Warwick station goes in the conduits two miles underground and for the rest of the way on poles.

At the Warren station there are located three 75-kilowatt, 10,000 to 2,200-volt transformers, at present working in parallel on the single-phase system. These transformers will be distributed on the phases of the three-phase system which is now in course of installation. The other substation has a similar arrangement of three 150-kilowatt transformers. At Warren there are in addition three 100-light, 6.6-ampere, constant-current transformers and regulators of the General Electric type, for supplying arc lights, and at the Warwick station there are four such equipments.

OPERATION.

The entire output of the company is sold to its consumers on the meter basis, except that the street lighting contracts are taken on the usual yearly basis of payment. General Electric meters are in use on the direct-current circuits, while meters of the Westinghouse and Fort Wayne pattern are used on the alternating service. All these meters are mounted in glass cases, allowing their working parts to be seen. Consumers are charged a flat

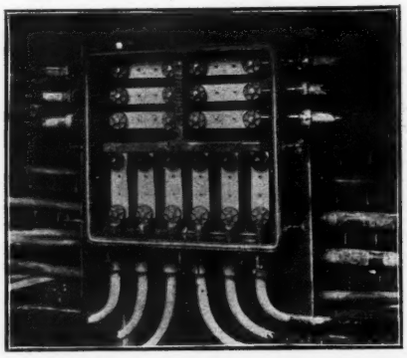

FIG. 15.—ONE OF THE MAIN TIE-BOXES IN A STREET MANHOLE.

rate per kilowatt-hour with discounts according to the amount of current used. Lamps are renewed free of charge upon presentation of blackened or burned-out lamps at the company's office. It is proposed in the future to carry on a systematic canvass of the circuits with a view to replacing bad lamps as quickly as pos-

FIG. 16.—CONDUIT CONSTRUCTION IN DORRANCE STREET, PROVIDENCE.

sible without waiting for the customers to bring them in.

The general policy of the company has been to maintain its service in the most efficient condition possible and to hamper its customers as little as possible with regulations or differentiation of charge which would be incomprehensible to the majority of them. For this reason there has been no attempt to introduce any maximum-demand or stated-hour use system of charge; it has been attempted to put the service on the same basis that the water supply service is on—current always available at the same price whenever it is wanted. To this liberal policy, no less than to the excellent engineering features of the installation, may be ascribed the excellent financial success which has attended the operation of the company. The Narragansett Electric Lighting Company was incorporated in its present form in 1884, with a capital of $150,000, which has grown to $3,000,000 since that time. It has at present over 500 stockholders, of whom nearly all are residents of Providence, and to them it is paying a regular dividend of eight per cent per annum. The stock, which has a par value of 50, is quoted on local exchange at 95. The company has issued no bonds and owns its installation and properties in fee without encumbrance. The officers, under whose direction and management this excellent result has been obtained, are as follows:

Harvey E. Wellman, president; Marsden J. Perry, vice-president and general manager; D. A. Pierce, treasurer; Walter I. Barnes, general superintendent; William C. Woodward, electrical engineer; F. N. Bushnell, mechanical engineer.

Perhaps most of the success of the company, both in its financial and engineering work, has been due to the energetic and brilliant management of Mr. Perry, who has largely built up this fine property by his personal efforts.

## American Trade with China.

The official statistics of the Chinese Government show the total imports from the United States in 1900, the latest year for which reports have been received, at 16,724,000 haikwan taels, or $11,757,000. This, however, does not include all of the United States merchandise entering China, since the exports from the United States to Hong Kong are equal to about one-half of those exported direct to China, and presumably a very large proportion of the exports to Hong Kong is destined ultimately for the Chinese markets. During the early years of the decade ending with 1900 exports to Hong Kong were larger than those to China direct, but the Chinese ports have been steadily gaining upon Hong Kong, and in the fiscal year 1900 the shipments from the United States to ports of China were nearly double the amount of shipments to Hong Kong, being for China $15,259,167, and to Hong Kong $8,485,978. It appears, therefore, that the total value of goods entering China from the United States is now about $24,000,000 annually, while our imports in 1900 from China and Hong Kong combined amount to $28,153,193, of which $26,896,926 was from China and $1,256,267 from Hong Kong.

### Electric Driving of Machine Tools.

At the Naval Construction Works, in England, the installation of electrically driven machine tools is very complete. The power station consists of five generating sets, the total horse-power being 1,250, and the electrical capacity 750 kilowatts, but in the engineering and gun-mounting department the power plant is of 2,500 horse-power and 1,500 kilowatts capacity, and electrical connection is established between the two departments. These stations are utilized both for power and lighting purposes, the voltage of the direct current being 210, with 3,570 amperes, in the shipyard department and 7,150 amperes in the engineering works. As to the economy of the electrical system, the coal consumption over a given period of average working conditions is only one-third what it was for steam driving, but the interest and depreciation of the electrical equipment must be taken into consideration. This, however, is not likely to equal the coal economy, while there is the additional advantage of direct control over the motors.

FIG. 17.—METHOD OF WATER-PROOFING CONDUIT TRENCH, WHERE LAID BELOW HIGH-TIDE LEVEL.

Where the tools are conveniently situated for driving from shafting—as a rule where belt drive was formerly adopted—the shaft has been retained and a large electric motor conveniently placed for running it. This secures any advantage from stored-up power in the pulleys to assist in starting drills and cutting tools generally, while at the same time a less power of motor is possible, since all the machines are not likely to be simultaneously doing their maximum duty. In the machine shed, however, the majority of the tools have independent motors, the largest being 45 horse-power, operating plate-bending rolls 30 feet long to take in armor deck-plates, while there are several cases of from 30 to 20-horse-power motors.

Many of the motors drive their machine tools by belting, with belt-striking gear for reversing. Some of the punching and shearing machines, however, are driven by spur gearing, the pinion on the motor spindle being of soft material, to deaden the shock and reduce the vibration. In such cases the motor is itself reversible. In a few instances, for large mangle rolls, angle shears and angle beveling machine, a chain belt covered by a gear case is used.

As to the speed of the motors, all above five horse-power run at 600 revolutions per minute, the interposition of belt pulleys enabling the speed of the various machine tools to be reduced to the required rate of rotation. Motors of three horse-power, which are used for drilling, countersinking, joiner's saws, etc., are run at 850 revolutions. The two-horse-power motors, of which there are three or four, run at 1,200 revolutions per minute, two one and one-half-horse-power motors make 1,100 revolutions per minute, while several one-horse-power motors, used for grinding, for saws and for several portable tools, make 1,300 revolutions per minute.

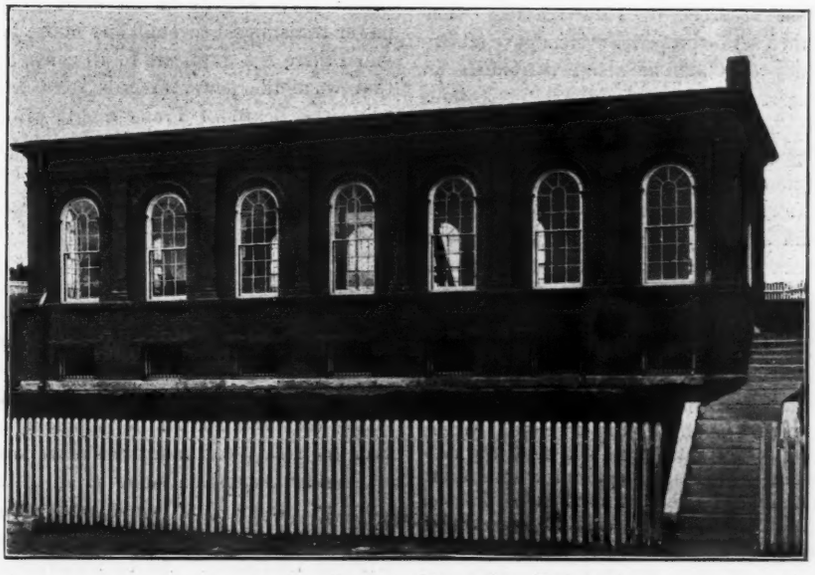

FIG. 18.—THE WARWICK SUBSTATION BUILDING.

### Electrical Tramway and Lighting in Guayaquil.

Mr. Perry M. De Leon, United States Consul-General at Guayaquil, sends the information that the municipal council of Guayaquil has recently granted to a syndicate a charter authorizing the construction of an electrical tramway system in that city of some 50,000 inhabitants. The charter permits the use of any of the streets of the city and provides for the construction of a new race course, including a bicycle track, in the suburbs of the town. It also grants the use of electricity for lighting and power.

The concession runs for 35 years, at the end of which time the tram and race course will revert to the city without compensation.

At present, Guayaquil has a very poor mule-car system, despite which dividends have been superb—25 per cent annually for a number of years past.

The principal streets of the city are lit by gas of an inferior quality—some sections by kerosene lamps.

The mule-car system will probably be bought out and absorbed by the new company, which is now seeking capital in the United States. The matter is worth the attention of those interested in this line of business.

### Electric Haulage on Canals.

In a communication to the Société Belge d'Electriciens some numerical data are furnished by Mr. L. Gerard relating to the various systems of electric traction on canals, calculating the efficiency as the ratio of power actually developed in the tow rope to the electrical power applied. As the result of trials, the Köttgen rack system, on the Finow Canal, showed a maximum efficiency of 0.704 when towing a 100-ton barge at two and one-third miles an hour. The tractor worked up to 20 electric horse-power at most, with an electric horse-power when running light at four and two-thirds miles an hour. The Denèfle tricycle (old form), on the Aire and Deule, gave an efficiency of 0.414 when towing a barge of 293 tons at one and three-quarters miles an hour, with a maximum power of 19.2 electric horse-power. Running light at two and one-third miles an hour, the tricycle took 4.17 electric horse-power. A new pattern of the tricycle gave an efficiency of 0.44 with the same load at one and two-thirds miles an hour. The Gerard tractor gave 0.534 at two and one-quarter miles, towing two 70-ton barges, and took 5.5 horse-power at two and three-quarters miles empty. Figures are given relating to the power absorbed by road friction. The Gerard screw-propeller system gave an efficiency of 0.322 at about two miles an hour, the screw making 375 revolutions per minute when towing two 70-ton barges, taking 5.4 horse-power at 5.1 miles an hour empty. This result is compared with steam practice, for which a maximum efficiency of 0.294 is given. Commenting on these figures, the author points out that the cost of maintenance of the banks and of the tractors will, in many cases, more than outweigh the low efficiency of the electric towage system, while in addition the banks are often unfit to bear the weight of the tractors. Where these considerations do not hold, the rack system is the best, except for low speeds and roads, which are best handled by tractors without rails. The effect on the section of the canal and the strong influence of the current along it are next dealt with, and the very important question of the state of the towpath is considered in detail. The author shows that the loss due to rolling friction may amount to 35 per cent. By comparing figures obtained with animal haulage with those of electrical haulage, an increase of over 42 per cent in the voyages annually made by a barge is shown in favor of the latter. In conclusion, the author emphasises the advantages gained by the electrical distribution of energy along the line of the canal for lighting, pumping, dredging and motive power in general.

### Electric Light for Fog.

A good deal has been heard during the conduct of the recent English naval manœuvres of fog, says the *Mechanical Engineer*. Overtaken by this terror to all sailors, powerful electric lights were shown over the stern of each vessel, and, by means of these, each craft was enabled to anchor directly in line. The success of this manœuvre has called forth the suggestion that ocean liners when in narrow waters should carry over their bows, and well down near the water, a powerful electric light, which might serve to apprise smaller craft of the proximate approach of the liner.

### Report of Electrical Committee Appointed by London Chamber of Commerce.

A committee of experts appointed by the London Chamber of Commerce has recently had under consideration the subject of large power stations for the distribution of electric energy in bulk over wide areas. As a result of its investigations, the committee recommends that in such schemes the voltage permissible in the mains should be at least 20,000 volts, if precautions are taken similar to those found successful in other countries. It thinks there should be no limit to the power transmitted through any main, provided there is a duplicate in all cases, and that when the power exceeds 2,000 kilowatts the Board of Trade should always have records. It further recommends that more elasticity should be permitted in connection with conductors, especially of the overhead type. It is pointed out that the regulations for these are prohibitive of their use, whereas in America and on the Continent high-voltage current wires have been allowed overhead for 10 years in cases analogous to the large schemes at present under contemplation; and the committee states that commercial development has been the result, and industries must profit by similar permission being given in this country where the conductor passes through a rural district. The wires are without insulation. As to underground cables, it is pointed out that where the conductors are interwoven into a single cable, and where the neutral point of the system is earthed, the use of the metal sheath in addition to the lead covering should be optional, provided suitable mechanical protection is provided. The committee, too, considers that promoters should be permitted to place transformers up to the high voltages indicated on consumer's premises in substations of suitable design, and that there should be no limit to the power of such stations.

### Proposed Tunnel Between Scotland and Ireland.

An interesting paper was read before the railways section at the International Engineering Congress, at Glasgow, on the proposed tunnel between Scotland and Ireland. Mr. James Barton, member of council, Inst. C. E., the author, dealt with the subject in a very thorough manner. Referring to the water question, he gave his reasons for believing that it is not likely to be a very serious difficulty. In the first place, in the case of both the Severn and the Mersey tunnels, no large water leakage was encountered under the sea, the great Severn leak being fresh water and a quarter of a mile from the sea. This view is confirmed in the case of a tunnel driven for some distance under the River Forth by Sir Benjamin Baker, giving good ground for believing that the sea bed under the Irish Channel, which is generally covered by a slimy ooze, has throughout the ages during which it has been undisturbed gradually sealed all interstices, so that excavation sufficiently low may be expected to be fairly dry. Moreover, the water difficulty of the Severn Tunnel occurred in limestone strata of the coal measures, where fissures and underground channels are not uncommon; no such rocks are, in the opinion of Professor Hull and others, to be found in the Irish Channel. The working of the tunnel and the line from Stranraer to Belfast is proposed to be by electric motors, from two installations, one near the main shaft at each side of the channel. There seems no reason to doubt, says the author, that trains can be run regularly at a speed of 60 to 70 miles per hour through the tunnel, so that the time occupied in passing through it would be about half an hour, and the whole distance from Stranraer to Belfast, being without intermediate stops, could be done regularly under the hour. The ventilation of a tunnel after completion is, by the use of electric power, made comparatively easy. The products of coal combustion are the difficulty in all ordinary tunnels. Fans to send in a current at one end and draw it out at the other would set up a constant current in one direction, and probably be quite sufficient. A point worthy of notice which the author makes toward the end of his paper is that the provision of power for drilling the rock, as well as moving the wagons of material during construction, would probably best be attained from electric motors, and there seems little doubt that through the marls on the Irish side, and sandstone, if not through the silurian rocks, large excavating drills to form the whole heading, eight feet or nine feet in diameter, in one operation, may be constructed capable of doing even more rapid work than by the use of explosives.

# The Electric Lighting Industry of the United States.

**Some Hitherto Unpublished Facts and Figures Regarding One of the Most Important Applications of Electrical Engineering.**

THE QUESTION has often been asked, "How much is represented by the electric lighting industry, and how does this industry compare with other large directions of endeavor in capital invested, people employed, dividends earned, and general importance as a branch of the commercial activity of the country?"

In endeavoring to give an answer to this complex question it has been necessary to make a careful study of the data obtainable from all directions and to compile, as accurately as the circumstances permit, a table setting forth the features of the electric lighting industry which are of the most importance—the number of plants, their situation geographically, and the amount of invested capital represented by these undertakings. The table shown on this page represents the maximum of information obtainable in this direction today, and is complete up to September 1, 1901. On account of the impossibility of obtaining information regarding certain features, however, it may be said that the figures given are below the actual facts, both as regards the number of stations and the total of invested capital. It is believed that the number of stations given is very nearly correct, while it is possible that the figures for capital invested are as much as ten per cent low. The reason of this is that it has not been possible to obtain reports from all the stations in the United States concerning the amount of their outstanding securities.

In counting the number of stations isolated plants of all sorts were absolutely neglected, and the stations given in the total, 2,842 in number, represent only those actually doing business in public electricity supply in the United States. Under "capital" in the table the sums given include the outstanding stocks and bonds of the various corporations. While a total of more than $667,000,000 is shown, of course no one familiar with the field of electrical enterprise in this country will assume that this represents the actual sum in cash expended in the equipment of the stations. It is probable, however, that the total amount of cash money actually expended in the construction of electric light plants as represented in this table is between three hundred and four hundred million dollars.

**Table of the Electric Lighting Industry in the United States.**

| State. | Stations. | Capital. |
|---|---|---|
| Alabama | 23 | $2,372,500 |
| Arizona | 9 | 836,500 |
| Arkansas | 28 | 2,100,000 |
| California | 93 | 50,192,975 |
| Colorado | 45 | 19,705,000 |
| Connecticut | 39 | 21,384,000 |
| Delaware | 7 | 449,000 |
| District of Columbia. | 2 | 2,000,000 |
| Florida | 17 | 1,073,000 |
| Georgia | 37 | 2,132,000 |
| Idaho | 12 | 275,000 |
| Illinois | 258 | 30,156,550 |
| Indiana | 134 | 11,525,507 |
| Indian Territory | 4 | 73,500 |
| Iowa | 146 | 7,496,200 |
| Kansas | 53 | 2,947,500 |
| Kentucky | 43 | 6,172,800 |
| Louisiana | 15 | 2,259,400 |
| Maine | 47 | 5,113,100 |
| Maryland | 28 | 3,700,500 |
| Massachusetts | 101 | 45,375,000 |
| Michigan | 147 | 10,558,745 |
| Minnesota | 104 | 7,884,150 |
| Mississippi | 20 | 1,879,000 |
| Missouri | 103 | 25,472,520 |
| Montana | 21 | 2,259,400 |
| Nebraska | 32 | 2,480,900 |
| Nevada | 4 | 360,000 |
| New Hampshire | 40 | 4,632,015 |
| New Jersey | 62 | 64,429,000 |
| New Mexico | 5 | 255,000 |
| New York | 204 | 102,056,000 |
| North Carolina | 33 | 2,305,200 |
| North Dakota | 11 | 542,000 |
| Ohio | 188 | 21,879,700 |
| Oklahoma | 6 | 395,000 |
| Oregon | 31 | 5,164,950 |
| Pennsylvania | 228 | 110,008,000 |
| Rhode Island | 12 | 4,708,000 |
| South Carolina | 19 | 5,106,000 |
| South Dakota | 20 | 804,000 |
| Tennessee | 40 | 2,533,300 |
| Texas | 97 | 3,968,400 |
| Utah | 8 | 23,106,000 |
| Vermont | 37 | 1,500,300 |
| Virginia | 40 | 9,906,500 |
| Washington | 38 | 12,962,300 |
| West Virginia | 33 | 1,711,300 |
| Wisconsin | 93 | 22,685,600 |
| Wyoming | 9 | 927,000 |
| United States | 2,842 | $668,830,312 |

No accurate figures have been obtainable as to the number of people employed or the salaries paid, nor is it possible to obtain any figures from a sufficient number of stations concerning their earning capacity to make the tabulation of these results of any importance.

A study of the table discovers some very curious conditions. The largest number of separate electric light stations in any state is found in Illinois, while the largest capital invested is in Pennsylvania, which also possesses the second largest number of stations. Where consolidation has been active the number of stations is comparatively small with reference to the total capitalization. For example, California, with only ninety-three stations, shows a capitalization of nearly two and one-half times as much as Ohio, with 188 stations or over twice as many. Probably this is due in some measure to over-capitalization in the western state, and also to the fact that companies there control larger territory and by the liberal use of power transmission make one station serve a considerable area. In certain regions, again, it is noticeable that capitalization is evidently held within close bounds, as in the District of Columbia, where the capitalization is reported as only $2,000,000 for the fine electric lighting plants of the national capital.

The table represents the fruit of no inconsiderable work and is believed to be as accurate as any that can be produced in the present condition of the industry in this country. One fact is sufficiently evident, however, from it, and that is that electric lighting ranks among the foremost industries of the country in the amount of capital employed and its general importance as a department of industrial endeavor.

## THE ELECTRIC TRANSMISSION OF POWER FROM NIAGARA FALLS—V.

BY LEWIS B. STILLWELL.

In determining the temperature, thermometers were applied to the outside surfaces of the armature, as was done in testing the first three alternators, and in addition to this the much more delicate and accurate method of determining rise of temperature by increase in resistance of exploring cells placed in the ventilating slots of the armature core was adopted. The exploring coils were made of wire 0.0025 inch in diameter, which was furnished by a dealer in platinum wire. Our determination of the coefficient of resistance in rise of temperature, however, showed that the wire was not pure platinum. The coefficient of these exploring coils was determined by measurements of resistance at various temperatures ranging from ten degrees centigrade to eighty-five degrees centigrade, while coils were immersed in an oil bath. A series of measurements was made beginning at eighty-five degrees centigrade and reducing the temperature to ten degrees centigrade, from which point the temperature was again gradually raised to 85 degrees centigrade. During these measurements, the oil was stirred and the results obtained were gratifying, the maximum variation in the coefficient, as determined by a number of successful measurements, being less than one per cent.

The coefficients being thus determined, the lengths of the coils were so adjusted that an increase of 0.1 of an ohm in the resistance of a coil corresponded to a change of one degree centigrade in temperature. In determining the rise of temperature of the armature core, one of the exploring coils was located in the ventilating slot nearest the top of the armature, one in a slot about half-way between top and bottom, and one in the slot nearest the bottom of the armature. The exploring coils were wound on a thin piece of mica, about one inch in width, and three of these coils were placed about two inches apart and secured to a piece of fibre one inch in width and ten inches long. The coils were secured in place by a tape and the piece of fibre, with the taped coils, was inserted radially in the ventilating slots. Between the resistance coils and the iron of the armature core but one layer of linen tape intervened and the coils were thus brought into intimate contact with the iron and the armature.

The purpose of this arrangement was to observe the differences in the temperature of the armature core at several points along a radius, one of these points being located within an inch of the inner edges of the armature conductors, another being two inches nearer the vertical axis of the alternator, and a third four inches nearer the vertical axis of the alternator.

Measurement of resistance of insulation by a Wheatstone bridge is of very little practical value as it varies between wide limits, depending upon the temperature of the machine and the humidity of the air. The only important and conclusive test of insulation resistance of armature and field winding is a test of the dielectric strength by subjecting the insulation to a potential considerably in excess of that which it is designed to withstand in service. It is better of course to use a relatively very high potential for a short time rather than a moderately high potential for a longer time to avoid injuring the insulation. In the factory, the insulation of each bar of the armature winding of the first ten alternators was tested by applying 15,000 volts, alternating, for a period of one minute. The insulation of the completed armature as erected in the power-house was tested by applying 6,000 volts, alternating, for a period of ten minutes between the conductors and the iron core. Insulation of the field winding was tested by applying 2,000 volts, alternating, for a period of ten minutes. In all of these tests, the form of the potential wave during a half cycle was approximately a sinusoid.

With respect to ability of the armature winding to withstand the strains of magnetic attraction and repulsion caused by short-circuits, the winding of the new alternators proved less satisfactory than that of the first three machines. The magnetic force exerted momentarily by the enormous currents flowing through the armatures and external circuits when a failure of cable insulation resulted in a short-circuit can be realized from the statement that lead-covered insulated conductors of 1,000,000 centimetres section, weighing upward of four pounds per linear foot, have been thrown off from their supporting brackets to a distance of five or six feet, and in at least one instance a cable of this kind was thrown from the brackets on one side of the bridge between the power-house and the transformer-house with such force that a considerable length of it was caught by the projecting cable supports on the opposite side of the bridge and did not fall to the floor. In this instance the cable was thrown a horizontal distance of approximately five feet while falling not more than two and one-half feet. The strain upon the connectors and armature bars of these alternators where they project above and below the core is very great under conditions of short-circuit such as these, and in a number of instances the armature bars of the new alternators have been sufficiently bent to damage the insulation. This difficulty has been overcome by inserting wooden spacing strips between the projecting ends of the armature bars. The point is one of importance, and should not be overlooked in the design of large dynamos. The trouble is caused apparently by the excessive stray magnetic field when the machine is short-circuited. The stray field is less in the later machines than in the first three alternators, but the armature bars are but half as thick—seven-thirty-seconds inch as compared with seven-sixteenths inch—and a greater tangential movement is therefore possible.

I would ask you to carefully note that the changes introduced in the design and construction of the alternators 4 to 10 as compared with the first three alternators in no sense materially affect the commercial usefulness of the machines. Considering the machines with reference to their money-earning power, there is little to choose between the first three alternators and their successors. The advantages of the latter may be summed up in the statement that their efficiency is about three-tenths of one per cent higher, that their regulation is somewhat closer, and that their limiting temperature under continuous full load is about fifteen degrees centigrade lower.

The armature insulation of none of the first three alternators has broken down in commercial service, and examination of the insulation of bars which has been in use since 1895 shows no apparent deterioration. It would seem safe to conclude, therefore, that a temperature rise of sixty centigrade degrees above surrounding air or absolute temperatures in continuous service ranging from eighty-five degrees centigrade to one hundred centigrade degrees, acts very slowly, if at all, in causing deterioration of the micanite insulation used in this case. The improvements embodied in alternators 4 to 10, in so far as they are practically material, are the result of improved methods of manufacture rather than improvements in design.

### VIII—THE EXCITERS.

During the period of construction, current for exciting the fields of the alter-

nators was obtained from a 75-kilowatt continuous-current engine-driven generator and from 200-kilowatt rotary converters, two of which were installed for this purpose. These converters were, of course, supplied through step-down transformers and in the winding of these transformers provision was made for adjustment of the ratio of transformation, and consequently for adjustment of the potential of the continuous current delivered. A rheostat in the field of each alternator affords means for the necessary adjustment of potential.

When the wheel-pit was extended to permit installation of the fourth and succeeding units, provision was made for turbine-driven exciters, of which four are now in use. These exciters are of 125 kilowatts output; their speed is 550 revolutions per minute. One of them is capable of exciting the entire battery of ten alternators, but it is usual to keep two in operation for this purpose.

Excitation by separately driven exciters is preferable to excitation from rotary converters, since in the latter case variations of potential at alternator terminals are increased by reason of the fact that the potential of the exciting current delivered to the fields varies in sympathy with the changes due to variations in the external load. An increase in load, therefore, reduces the potential delivered to the alternating-current circuits not only by reason of drop due to resistance and reaction of armature, but also by reason of a practically simultaneous reduction in strength of field. This of course was understood when the converters were put in, and they were installed only as a temporary expedient, pending installation of turbine-driven exciters which could only become possible when the wheel-pit was extended.

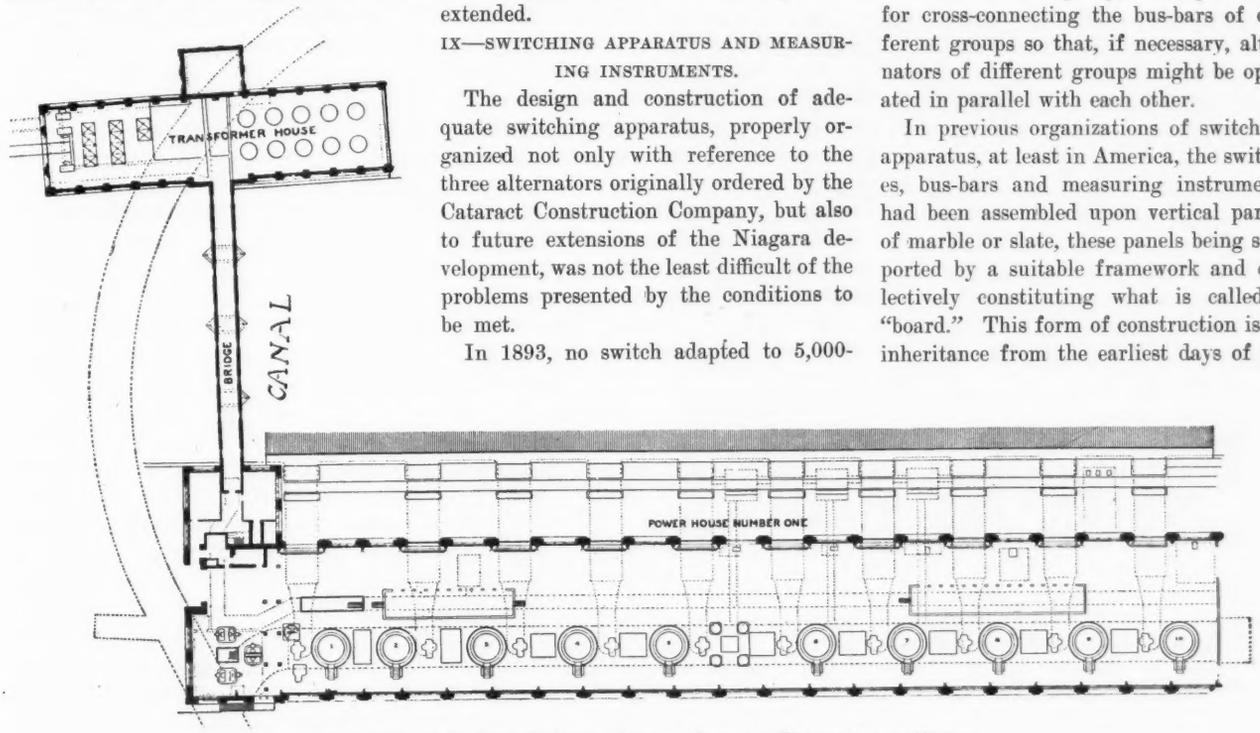


FIG. 9.—PLAN OF POWER-HOUSE NUMBER ONE AND TRANSFORMER-HOUSE.

### IX—SWITCHING APPARATUS AND MEASURING INSTRUMENTS.

The design and construction of adequate switching apparatus, properly organized not only with reference to the three alternators originally ordered by the Cataract Construction Company, but also to future extensions of the Niagara development, was not the least difficult of the problems presented by the conditions to be met.

In 1893, no switch adapted to 5,000-horse-power circuits had been constructed, and, so far as I am aware, no switch fitted to meet the conditions, both of large current—1,000 amperes per pole—and comparatively high potential—2,200 volts, alternating—had been attempted.

As to the general organization of apparatus, it was necessary to provide not only for the three initial alternators, but also for the operation of additional machines, of which it was expected that as many as fifteen or twenty might be located in power-house No. 1, while others, to a possible ultimate number of forty, on the American side of the river, and fifty on the Canadian side of the river, might be installed. It was obviously essential also that the switching arrangements must be such as to permit operation of any or all alternators in parallel.

To meet the conditions, it was decided to so organize the switching apparatus as to provide for operation of the alternators in successive groups of five, the alternators of each group being connected to switching apparatus centrally located with reference to the group, with provisions for cross-connecting the bus-bars of different groups so that, if necessary, alternators of different groups might be operated in parallel with each other.

In previous organizations of switching apparatus, at least in America, the switches, bus-bars and measuring instruments had been assembled upon vertical panels of marble or slate, these panels being supported by a suitable framework and collectively constituting what is called a "board." This form of construction is an inheritance from the earliest days of the commercial dynamo, when it was natural to place the switch and the ammeter and voltmeter at first upon a wall of the dynamo room, and later—when the advantages of running wires behind the "board" and the necessity of going behind it to look after connections, etc., had become apparent—upon a vertical switchboard independently supported and sep-

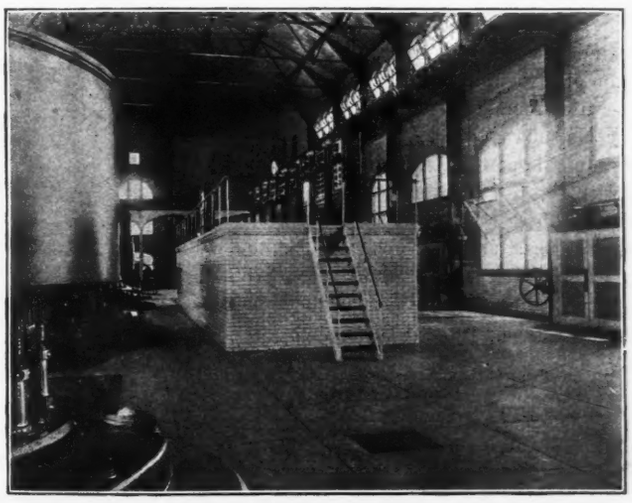

FIG. 10.—INTERIOR VIEW OF NIAGARA POWER-HOUSE.

arated from the wall of the room by a suitable space.

The dimensions of a switch adapted to a 5,000-horse-power, two-phase, 2,200-volt alternator, as fixed by size of contacts necessary to carry the current and by distance between terminals required by the comparatively high potential, were such that operation by hand was considered impracticable and it was decided to employ pneumatic pressure to throw the switches. This made it possible to locate the switches at a distance from the operator, who would thus be removed from danger in case of a short-circuit in the switches or a dangerous arc. Danger to the operator from accidental contact with changed terminals would also be eliminated in this way.

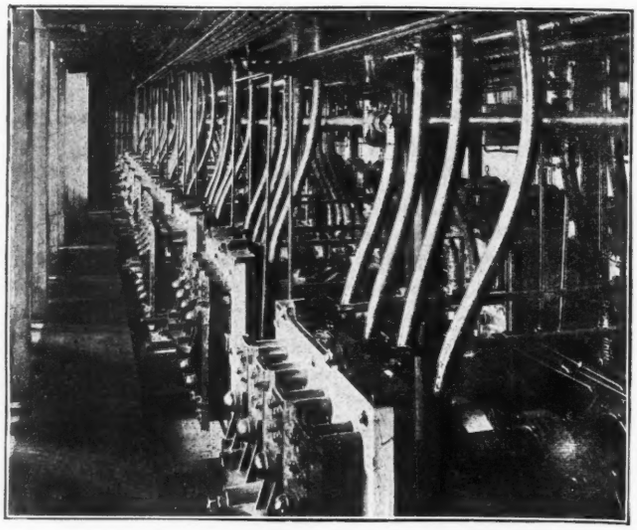

FIG. 11.—GROUP OF SWITCHES.

These being the general considerations in mind, the switching apparatus for each group of five alternators was assembled in a switch room, or structure, erected over the cable subway which extends the entire length of the power-house on a line parallel with the row of alternators. The position of these structures, with reference to the alternators, is shown in Fig. 9, and exterior and interior views are shown in Figs. 10 and 11. The 5,000-horse-power switch itself is illustrated in Fig. 16.

The four leads from each alternator are connected to the bottom terminals at opposite ends of a switch; the upper terminals are connected by short pieces of insulated cable to the bus-bars which are supported in a horizontal position above the switches. Two sets of bus-bars are provided and any alternator may be connected to either set. Connections for the feeder switches are similar to those for the alternator switches except that bus-bars are connected to the upper terminals and the outgoing cables to the lower terminals at each end of the switch. The bus-bars are insulated by vulcanized rubber covered with braid and wrapped with twine. After erection, they were subjected to a puncture test of 10,000 volts, alternating. The bus-bars taper from the middle toward each end, the section at all points being proportioned to the maximum current which may traverse the bars. They are circular in form, the end sections being copper rods one and one-eighth inches in diameter and the intermediate sections copper tubes, the largest being about three and one-half inches in diameter. The rods constituting the end sections are threaded and screwed in the ends of the adjacent tubes, which in turn are threaded and screwed into the ends of the large tube constituting the middle section of the bar. The fitting and insulating of these bars was a work requiring much care and skill; it was admirably carried out by Dr. W. M. Habirshaw, manager of the India Rubber and Gutta Percha Insulating Company, Yonkers, N. Y., whose firm also supplied all cables for dynamo leads and connections.

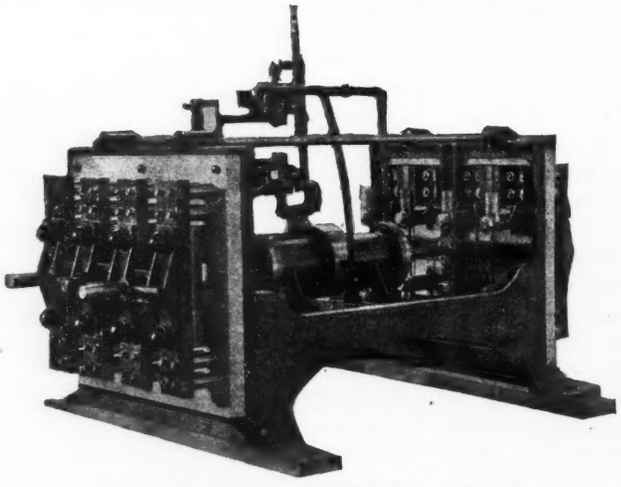

FIG. 12.—FIVE-THOUSAND HORSE-POWER SWITCH.

The switches are supported upon I-beams which span the cable subway. While I do not regard these switches as absolutely reliable in opening circuits conveying several thousand horse-power, they have failed in service not more than two or three times since the plant was started and on the whole have done their work in a very satisfactory manner.

The ammeters and voltmeters, indicating wattmeters and synchroscopes, are mounted, not upon a board, but upon individual instrument stand, one stand being provided for each alternator. These stands are located upon the platform which constitutes the roof or ceiling of the switch room. In front of each alternator instrument stand is a smaller one carrying the levers by means of which air is admitted to the switch cylinders. For each feeder circuit, lever stands equipped with pilot lamps and drop indicators are located upon the upper platform of the switch structure within convenient reach of the operator. The drop indicators were not included in the original outfit, but were added at a later date after the feeder fuses were dispensed with. In case of short-circuit, they indicate to the operator which of the several feeder circuits is in trouble. They are constructed very like the drop indicators in a telephone switchboard.

For each phase of each feeder circuit, an indicating wattmeter and a watt-hour meter are provided. These instruments are not placed upon the switch structure, but are located in the superintendent's office, my theory being, at the time this installation was made, that the switch operator need see only the alternator instruments, while the division of load among the several feeders supplying different tenants of the company was a matter concerning the superintendent. Incidentally, also, this arrangement, by removing from the switching structure a large proportion of the measuring instruments, simplifies the organization of apparatus at that place, and improves the appearance of the platform of the switching structure which would otherwise be awkwardly crowded by instrument stands. An argument in favor of instrument stands as against instrument "boards," which considerably influenced the decision in favor of the former, was the fact that as instrument boards were then constructed it was not easy to put up a board for three alternators arranged for extensions to take care

of additional alternators, which would not look unfinished and incomplete until such time as the additional alternators might be installed.

The alternating-current measuring instruments used are of a very interesting type, invented by the late O. B. Shallenberger, whose untimely death, in 1898, was a most serious loss to applied science in electrical engineering. In their various modifications, these instruments constitute a complete series of indicating and integrating meters for single or polyphase alternating currents.

The 5,000-horse-power Switch — Fig. 12 shows the general arrangement and construction of one of the 5,000-horse-power, two-way, four-pole switches. Two independently operated pistons working in air cylinders placed back to back are used to open and close the switches. The current-carrying contacts are of the ordinary blade and jaw type. In opening the switch, when the moving blades leave the contact jaws, the arc—which would otherwise occur—is prevented by a shunt circuit having a considerable resistance. The small current which flows through this resistance is finally broken at auxiliary terminals of the plunger and socket type, the material used for these terminals being a certain quality of brass which does not readily arc. The non-arcing qualities of this material were discovered by Alexander J. Wurts and utilized by him in his well-known and valuable lightning arrester for alternating-current circuits. On the whole, these switches have been very satisfactory in operation. They can not be relied upon to open the circuit under short-circuit conditions, and were never intended for that purpose. They have been used, however, to open the circuits conveying large amounts of power, and they have done this successfully. Under test conditions they have repeatedly opened, without injurious sparking, the currents exceeding 1,500 kilowatts per phase. In opening the circuit by this switch, no appreciable rise of potential occurs. This point has been thoroughly demonstrated, as it was deemed possible that in suddenly opening heavy power circuits of considerable inductance and capacity, momentary abnormal rise of potential might be experienced. That no excessive rise does occur has been conclusively proved by tests, the method used being to place in parallel with the switch a spark-gap, consisting of two sharp terminals separated by an adjustable and known space.

Automatic Circuits—Opening Devices—In the original outfit of switching apparatus no fuses or circuit-breakers were used in the leads between the alternators and bus-bars, nor has experience ever indicated that they are desirable in these circuits. The leads from alternators to bus-bars are not long, and the potential is but 2,200 volts, alternating.

The conductors used have an eight-thirty-seconds-inch wall of vulcanized rubber, containing thirty per cent pure Para, this insulating wall being covered by a heavy braid, treated with compound to exclude moisture. With such insulation there is less danger of a breakdown between alternator terminals and bus-bars than there is in the armatures themselves, and considering the uncertainty of action of any automatic circuit-breakers or fuses available at the time, it was decided, I believe wisely, to install nothing of the kind in the alternator leads.

As regards feeders, the arguments in favor of automatic circuit-opening devices are much more weighty than in the case of the alternator leads, since occasional failures of cable in an extensive system of distribution are inevitable, and without automatic opening devices in the feeder circuits the entire battery of alternators connected to the affected circuit must be shut down in case of trouble. A serious effort was therefore made to provide suitable automatic circuit-opening devices. No circuit-breakers having been developed for this kind of service, fuses of a type furnished by the Westinghouse company and unquestionably the best available at that time were adopted. These fuses had some ingenious and excellent features, but, in service, ultimately proved a failure, and in 1898, after a year's experience in charge of operation of the plant, I removed all of them, and since then the plant has been operating without any automatic circuit-opening devices in the local distributing feeders at the power-house. Where the feeders enter the premises of the tenants using the power, fuses were originally used, and these have since been succeeded by circuit-breakers of which several types are now in service. The fuse originally used in the feeders at the power-house is of aluminum, and is enclosed between two lignum-vitæ blocks, in which spaces for the three parallel fuse strips are cut out. The arrangement is a development of the expulsive type of fuse originally designed by Alexander J. Wurts, vents from each of the three fuse chambers being provided, through which the vapor of the exploding fuse is expelled. The lignum-vitæ blocks are hinged at one end, and, when closed, are held together securely at the other end. When the blocks are in perfect condition, so that the only outlet for the gas formed by the explosion is through the vents provided for the purpose, they are effective, as was demonstrated not only by tests at Niagara preceding their adoption, but also by their action in commercial service. But in practice, owing to gradual shrinkage of the blocks, the exploding gas sometimes reaches the terminals and the fuse fails to clear. It was found in practice that the fuse itself, which, having exposed terminals, is necessarily an imperfectly insulated link in the circuit, caused more trouble than it prevented, and its use was therefore abandoned. Until the work of placing the local distributing cables in properly constructed conduits was completed—about two years ago—short-circuits upon some of the local distributing cables occurred much more frequently than was desirable, and the local service was occasionally interrupted when it probably would not have been interrupted if automatic circuit-breakers, such as can now be obtained, had been in use upon the feeder circuits. Since the work of relaying the cables has been completed, however, interruptions of local service due to failures in cables have been extremely rare, and as there is no space conveniently available in power-house No. 1 for the installation of feeder circuit-breakers it has not been thought wise to introduce them. Plans for power-house No. 2, however, contemplate the use of automatic circuit-breakers, and since adequate space will be provided for the improved type now available there is every reason to believe that they will be successful. Marked progress in construction of circuit-breakers for high-potential and large power circuits has been made since 1893. To this progress the experience and requirements of the Niagara Falls plant have in no small degree contributed, and some most interesting and instructive tests of automatic circuit-opening devices have been carried out jointly by engineers of the manufacturing companies and the staff of the Niagara Falls Power Company. I regret that the limits of this paper do not permit discussion of some of these tests.

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A twenty-horse-power electric gypsy has been installed at the Desbrosses street ferry of the Pennsylvania Railroad Company for the purpose of assisting heavily laden trucks in ascending the steep inclines of the ferry bridges during low tide. A rope is attached to the tongue of the truck when a team is unable to ascend the bridge and a couple of turns are taken around the gypsy when the power is applied by means of a controller. A second electric gypsy is now being built for the same ferry. At the Oak Point pier of the New York, New Haven & Hartford Railway, two electric gypsies have also been put in. At this place the current is strong and the water very deep, and these will be of assistance in pulling the boats up to the wharf.

## ELECTRIC STREET LIGHTING AND POPULATION.

BY ALTON D. ADAMS.

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Larger cities obviously have more electric street lamps than do smaller ones, but the proportion between the amounts of lighting and population is not so evident. Both arc and incandescent lamps are extensively used for the illumination of streets, but the relative extent of these two kinds of service seems to vary from place to place. It appears that an examination of the actual volume of electric street lighting in a large number of cities and towns, ranging in population from the smallest to those of very large size, should serve to bring out such relation as exists between the extent of population and the use of electric street lamps. Furthermore, this examination will reveal the proportion between the amounts of arc and incandescent street lighting in places with widely different numbers of inhabitants. It is desirable, for the purpose named, that accurate information of the numbers and kinds of electric lamps in use, as well as a wide and complete range of populations, be available in the cities and towns selected. Centres of population in the State of Massachusetts meet both of these requirements to an admirable degree, and are, therefore, chosen for the present inquiry. Massachusetts contains 31 cities having electric street lamps and ranging in population from 12,962, in Melrose, to 560,892, at Boston. Records of the electric street lamps used in all of these cities, and also those in 44 towns with an average population of 5,839 each, are here presented. Streets are lighted in these cities and towns with electric lamps of various illuminating capacities, from the 16-candle-power incandescent to the 2,000-candle arc. In order to get a comprehensive view of the lighting in different places, and also of the importance of the arc and the incandescent service, the kilowatt-hours consumed in the arc, also those consumed in the incandescent street lamps of each place, have been computed for the year ending June 30, 1900. As a basis for these computations, energy consumption at the rate of 0.25 watt per nominal candle-power of all arc lamps, and 3.5 watts per candle-power of incandescent lamps has been assumed. While these figures may not correspond to the actual facts of each particular case, they seem to be as near the truth as it is possible to get. The table presents the results of these computations, in the form of kilowatt-hours consumed by arc and incandescent street lamps, for all of the places named, during the above year.

A difficulty was at once encountered when a general review of the results presented in this table was sought, because many of the places are so close together in population that no definite tendency as to changes in the amount or kind of street lighting, to correspond with the numbers of inhabitants, can be detected between them. It was found easy to avoid this difficulty, however, by the combination of places having nearly equal populations into a group, and then taking the average population and the average kilowatt-hours in arc and in incandescent street lamps separately for each group.

On this plan, the cities of Boston, Worcester and Fall River each stand alone, and the remaining cities are combined into six groups. One group is composed of Lowell and Cambridge, with populations of 94,969 and 91,886, respectively. The second group contains all cities with populations between 68,513 and 61,643; the third group, cities from 45,712 to 40,063; the fourth, cities from 37,175 to 31,531; the fifth, cities from 26,121 to 21,766, and the sixth group, cities from 18,643 to 12,962 inhabitants each. A seventh group is made up of 44 towns, each with less than 12,000 population.

The average population for each group is found from a division of the total population of all its cities by the number of these cities, and the like average is found for the group of towns. To determine the average kilowatt-hours for each group, the sum of the kilowatt-hours consumed in its arc street lamps is divided by the number of cities in the group, and the sum of the kilowatt-hours consumed in its incandescent lamps is likewise divided by the number of cities. By this process seven average populations are obtained, with their corresponding averages for kilowatt-hours used in arc and incandescent street lamps. These averages, together with the results obtained for the three cities that stand separately, furnish 10 populations with their figures for the consumption of energy in street lamps, and these populations are far enough apart so that the changes in proportion and kind of electric lighting can be clearly brought out.

To illustrate more clearly the relations between populations and the amounts of energy used in arc and incandescent lamps for street lighting, five curves have been drawn. The population of Boston is nearly five times as great as that of Worcester, the next largest city, while the energy consumed in electric street lamps at Boston is more than eight times the amount in Worcester. Because of these large figures for Boston, it can not be included in the curves numbered 1, 2, 3 and 5 at any desirable scale, but is represented in curve 4.

Energy used in electric street lamps, during the year ending June 30, 1900:

| | Population. | Kilowatt-hours in Arc Lamps. | Kilowatt-hours in Incandescent Lamps |
|---|---|---|---|
| Boston, | 560,892 | 10,075,867.20 | 5,916.47 |
| Worcester, | 118,421 | 1,225,728.00 | 7,293.08 |
| Fall River, | 104,863 | 1,276,508.16 | |
| | GROUP I. | | |
| Lowell, | 94,969 | 956,304.96 | |
| Cambridge, | 91,886 | 625,318.27 | 212,030.50 |
| | GROUP II. | | |
| Lynn, | 68,513 | 484,958.08 | 383,789.26 |
| Lawrence, | 62,559 | 364,183.48 | 114,636.20 |
| New Bedford, | 62,442 | 341,153.28 | 11,796.28 |
| Springfield, | 62,059 | 867,552.76 | 31,361.27 |
| Somerville, | 61,643 | 432,069.12 | 100,816.13 |
| | GROUP III. | | |
| Holyoke, | 45,712 | 303,761.66 | |
| Brockton, | 40,063 | 299,033.86 | 24,366.93 |
| | GROUP IV. | | |
| Haverhill, | 37,175 | 330,745.56 | 327.88 |
| Salem, | 35,956 | 359,619.84 | 275,445.59 |
| Chelsea, | 34,072 | 264,844.80 | 72,330.72 |
| Malden, | 33,664 | 90,622.82 | 246,120.00 |
| Newton, | 33,587 | 223,388.92 | 176,530.36 |
| Fitchburg, | 31,531 | 307,975.10 | |
| | GROUP V. | | |
| Gloucester, | 26,121 | 27,197.82 | 73,679.77 |
| Everett, | 24,336 | 45,411.84 | 63,441.00 |
| North Adams, | 24,200 | 167,311.87 | 20,913.98 |
| Waltham, | 23,481 | 101,013.12 | 11,190.90 |
| Quincy, | 23,899 | 47,548.80 | 52,283.87 |
| Pittsfield, | 21,766 | 48,025.65 | 84,791.83 |
| | GROUP VI. | | |
| Northampton, | 18,643 | 75,553.20 | 1,565.38 |
| Medford, | 18,244 | 54,634.61 | 74,431.88 |
| Newburyport, | 14,478 | 71,834.68 | 1,979.87 |
| Woburn, | 14,254 | 32,756.54 | 43,251.18 |
| Beverly, | 13,884 | 159,980.68 | |
| Marlboro, | 13,609 | 38,413.44 | 42,325.92 |
| Melrose, | 12,962 | 23,850.00 | 66,223.50 |

Average population and energy for each group:

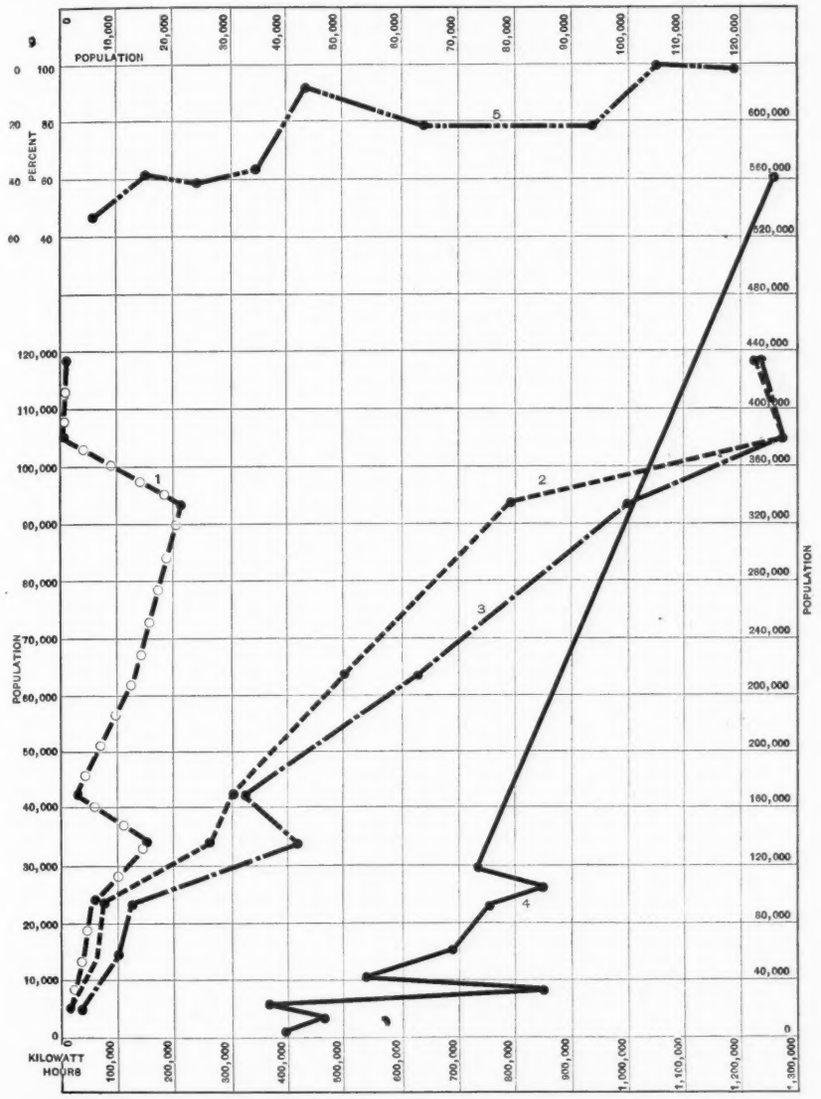
| Average Population Each Group | Average Kilowatt-hours Arc Lamps. | Average Kilowatt-hours Incandescent Lamps. | Average of Total Kilowatt-hours |
|---|---|---|---|
| 560,892 | 10,075,867.20 | 5,916.47 | 10,081,783.67 |
| 118,421 | 1,225,728.00 | 7,293.08 | 1,263,021.08 |
| 104,863 | 1,276,508.20 | | 1,276,508.20 |
| 93,427 | 790,811.50 | 212,030.50 | 1,002,842.00 |
| 63,443 | 497,983.20 | 128,479.80 | 626,463.00 |
| 42,887 | 301,397.76 | 24,366.93 | 325,764.69 |
| 34,330 | 262,866.00 | 154,151.00 | 417,017.00 |
| 23,967 | 72,751.51 | 51,050.16 | 123,801.67 |
| 15,153 | 62,289.00 | 38,296.33 | 100,585.33 |
| | FOR 44 TOWNS. | | |
| 5,839 | 15,325.40 | 17,473.55 | 32,798.95 |

Curve No. 1 represents the average energy consumed by incandescent street lamps in the group of 44 towns, the six groups of cities, and in each of the two smaller cities that stand alone.

This curve is drawn to the scale of kilowatt-hours numbered from 0 to 1,300,000

at the lower edge of the sheet, and to the scale of population numbered from 0 to 120,000 along the left side. Starting at its lowest point, representing the 44 towns, the curve shows a large though irregular increase of the energy consumed by incandescent street lamps, until the point representing cities with an average population of 93,427 is reached. From this point the curve drops to zero energy at Lowell, with a population of 104,863, and barely moves from the zero line on its way to Worcester, the highest point. The largest average use of incandescent street lamps is seen in cities of 93,427, and this is due entirely to the large application of such lamps in Cambridge, as may be seen from the table.

Population considered, places of between 30,000 and 40,000 inhabitants consume more energy in incandescent street lamps than any others, as may be gathered from the position of the point representing an average of 34,330 persons. In the towns the average energy in incandescent is slightly greater than that in arc lamps. but this condition is more than reversed in the first group of cities. The total amount of energy consumed in the incandescent street lamps of all the cities and the 44 towns is 2,967,675.5 kilowatt-hours.




Curve Showing Relation Between Electric Street Lighting and Population.

Curve 2 represents the average amount of energy yearly consumed by arc street lamps in the seven groups and two separate cities. This curve is drawn to the same scales as curve 1. After leaving the point that indicates the 44 towns, where the energy consumed in incandescent street lamps is a little more than that in arcs, the arc curve indicates a decided increase in the relative amount of arc street lighting. After the points indicating an average population of 23,967 are reached, the two curves move rapidly apart, and the maximum distance between them occurs at the points representing a population of 104,863, where arc lamps do all of the electric street lighting. Beyond these points the use of incandescent lamps is insignificant.

The total kilowatt-hours consumed by arc lamps in all of the cities and towns represented on the arc curve are 20,397,509.9 or 6.87 times the 2,967,675.5 kilowatt-hours used in all the incandescent lamps.

Curve 5 shows the relative amounts of energy consumed by arc and incandescent street lamps from the 44 towns to the city of Worcester. This curve is drawn to the scale of per cent along the upper left-hand edge of the sheet, and to the scale of population from 0 to 120,000 across the top. Figures in the scale of per cent from 0 to 60 refer to the proportion of total energy for each group, used by incandescent lamps, and figures from 40 to 100 refer to the proportion of total energy used by arc lamps. The exact figures for the per cent in each case are as follows for the several average populations. At Boston, which is not included in the curve, the arcs consume more than 99.9 per cent of the total energy in street lamps.

Relative amounts of energy in arc and incandescent lamps:

| Average Population. | Per Cent Kilowatt-hours in Arc Lamps. | Per Cent Kilowatt-hours in Incandescent Lamps. |
|---|---|---|
| 560,892 | 99.9 | 0.0 |
| 118,421 | 99.4 | 0.5 |
| 104,863 | 100.0 | 0.0 |
| 93,427 | 78.8 | 21.1 |
| 63,443 | 79.4 | 20.5 |
| 42,887 | 92.5 | 7.4 |
| 34,330 | 63.0 | 36.9 |
| 23,967 | 58.7 | 41.2 |
| 15,153 | 61.9 | 38.0 |
| 5,839 | 46.7 | 53.2 |

This per cent curve indicates a general decline in the proportion of arc street lighting as the average number of inhabitants per place grows smaller, between populations of 104,863 and 5,839. The relative amounts of energy in the two kinds of lamps, after falling to about 79 per cent of the total for arcs and 21 for incandescent lighting remain at this ratio through cities of 93,427 and 63,443 average populations. The rise in the proportion of arc lighting for cities of 42,887 population is due to the fact that there are only two cities of this size, and one of them has no incandescent street lamps. Cities with average population of 34,330 show a decided increase of incandescent street lighting, which here consumes 36.9 per cent of the total energy. A slight gain on this figure is made by the incan-

descent lamps in the two following groups of smaller cities, and then comes their rise to a consumption of 53.2 per cent of the total energy used in street lighting by the 44 towns.

Total energy in electric street lamps:

| Average Population of Group. | Total Kilowatt-hours in Ar. Lamps of Group. | Total Kilowatt-hours in Incandescent Lamp of Group. |
|---|---|---|
| 560,892 | 10,075,867 | 5,916 |
| 118,421 | 1,225,728 | 7,293 |
| 104,863 | 1,276,508 | |
| 93,427 | 1,581,623 | 212,030 |
| 63,443 | 2,489,916 | 642,399 |
| 42,887 | 602,795 | 24,367 |
| 34,330 | 1,577,197 | 770,755 |
| 23,967 | 436,509 | 306,301 |
| 15,153 | 457,023 | 229,778 |
| 5,839 | 674,339.9 | 768,836.5 |
| | 20,397,505.9 | 2,967,675.5 |

From the table of total energy for the several cities and groups, it appears that Boston requires one-half of all the kilowatt-hours consumed in arc street lamps. Of the remainder of the arc lamp service, one-half is performed in cities having populations between 60,000 and 70,000. The 44 towns consume only about three per cent of the total energy in arc lamps. Cities between 30,000 and 40,000 require more energy than any of the other groups for incandescent lamps, and these with the smaller places contain more than two-thirds of the incandescent street service. The towns alone furnish more than one-fourth of the entire demand for incandescent street lighting.

Curve 3 exhibits the average consumption of energy in both kinds of street lamps for the several separate cities and groups. This curve is drawn to the same scales as curves 1 and 2, and further illustrates the rapid increase of electric street lighting with population.

At its lowest point the curve of total energy is about equal distant from the curves of arc and incandescent kilowatts, but for the city of 104,863 population the arc curve touches the curve of total energy, and for larger cities these two curves nearly coincide.

It now remains to determine more definitely the relation between the increase of population and the use of electric street lamps. For this purpose curve 4 is drawn, showing the kilowatt-hours used by all electric street lamps in the three separate cities, and all the groups, per 70,000 inhabitants in the average population of each. The unit of population is taken at 70,000 simply to bring curve 4 in a position on the sheet where it does not interfere with the others. So far as the indicated results are concerned, any other unit of population might have been used. Curve 4 is drawn to the scale of kilowatt-hours along the lower edge of the sheet, as are curves 1, 2 and 3, but its scale of population is placed at the right-hand side and runs up to 600,000, so as to include Boston. The following table contains the figures for kilowatt-hours for each city and group, per 70,000 population, to which the curve is drawn. The energy for each city or group is given in thousands of kilowatt-hours. The most striking element of the curve is that between the points representing Worcester and Boston, which shows an increase from 73.0 thousand kilowatt-hours per 70,000 population at Worcester, to 125.8 thousand kilowatt-hours at Boston. Between Worcester and Fall River the curve regains a little of its previous loss, and stands at 85.0 thousand kilowatt-hours per 70,000 population for the latter place. From a population of 104,863 to cities with an average of 42,887 inhabitants, the curve shows a rapid decrease in the relative amount of energy, it being only 534 thousand kilowatt-hours per 70,000 population for this group. That portion of the curve running out to the point for cities with an average population of 34,330, represents a notable rise in the amount of energy for street lighting per unit of population, these cities having 851 thousand kilowatt-hours in street lamps per 70,000 inhabitants, or more than any other city except Boston. This relatively large use of electrical energy in street lamps is all the more important because there are six cities in this group, so that the high figure can not be assigned to some exceptional circumstance in a single place. The smallest use of energy in street lamps, represented by this curve, is found in the next lower group of cities, where only 362 thousand kilowatt-hours are consumed per 70,000 persons. Some gain on this figure is made in the group of smallest cities, and is not entirely lost in the towns. Following is a table of the energy per 70,000 population for each separate city and group, also the per cent of the energy used by each group to the energy used at Boston per 70,000 inhabitants.

| Population. | Thousands of Kilowatt-hours Per 70 000 Population. | Per Cent of Kilowatt-hours per 70,000 Population to like Kilowatt-hours at Boston |
|---|---|---|
| 560,892 | 1,258 | 100 |
| 118,421 | 730 | 58 |
| 104,863 | 850 | 67 |
| 93,427 | 754 | 59 |
| 63,443 | 691 | 54 |
| 42,887 | 534 | 42 |
| 34,330 | 851 | 67 |
| 23,967 | 362 | 28 |
| 15,153 | 465 | 37 |
| 5,839 | 395 | 31 |

From this it appears that places of less than 30,000 inhabitants use about one-third as much energy in street lamps as Boston, per unit of population.

### Utilization of Water Powers in Norway by Electricity.

A great electric power system is in course of construction at present in Norway. It is situated on the Glom stream, which runs from the centre of Norway toward the southwest and enters into the Fjord of Christiana. It is intended to furnish Christiana and the neighboring towns with electric energy for lighting and power. Near the river they have built dams and constructed canals a thousand millimetres in length to supply the turbines. These power-houses are situated about 40 kilometres from the capital and are intended to develop respectively 16,000 and 10,000 horse-power. Most of the capital for establishing this enterprise has been subscribed for in England.

### Rubber Culture in Perak.

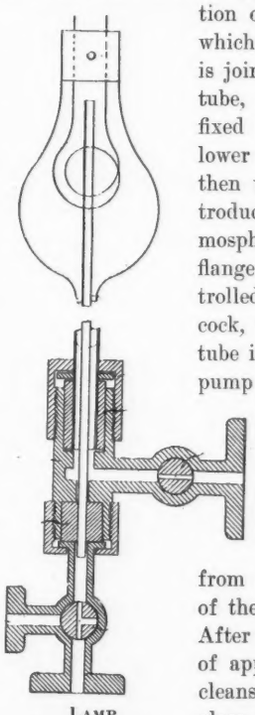
United States Consul General Guenther, of Frankfort, has sent the following: The *De Indische Mercuur* states that the director of the government plantations has issued a report on the results of cultivation in the district of Perak, on the Malayan Peninsula. By moderate tapping of 82 Para rubber trees, averaging 14 years of age, 327 pounds of first-class and 33 pounds of second-class rubber were produced. The first-class, equal to the best Para rubber, was sold in London at 3s. 10d. (93 cents); the second-class, at 2s. 6d. (61 cents) per pound. Each tree yielded about two pounds of rubber. The results were said to be encouraging for planting rubber trees where the soil and the climate were favorable.

### Demand for Electric Plant in Greece.

News comes from United States Consul McGinley, at Athens, Greece, that the mayor of Karpenesion, a village in the province of Evrytania, wishes to have that place lighted by electricity, and has requested the consulate to publish the fact in the United States, hoping to induce some American company to sell him a suitable plant. There is a stream near the village that can be utilized to furnish the necessary power for the plant. There are 400 houses in the village, and the mayor estimates that about that number of incandescent lights will be required. He does not mention the number of arc lights required. Karpenesion is the village which the heroic Greek chieftain, Marco Bozzaris, was defending when, in 1823, he fell in a midnight sortie against the Turks, an event made famous by Fitz Greene Halleck's stirring poem.

# Electrical Patents

A new mode of manufacture and repair of incandescent electric lamps has recently been patented in this country by Mr. Ferdinand Fanta, of London, England. It has hitherto been believed that the whole body of the filament in an incandescent electric lamp volatilizes or burns away and loses in value in regard to its transmitting and lighting efficiency and that the "core," so to say, of the filament is destroyed; but it has been found that this is not the case, but, on the contrary, that the core or body of such filament is, after having been in use for several hundred hours, in a better condition than when originally inserted into the lamp. This is accounted for by the fact that the original carbonizing process, which the filament has to undergo before its insertion into the bulb, is performed too rapidly, and, further, that the process known as the "reenforcing" or "flashing" of the filament is carried out under unsatisfactory conditions, and these conditions are in most instances entirely at variance with those under which such filament comes into use in the finished lamp. The result of this is that when the filament is used, as it is in actual practice, in a more or less perfect vacuum, and owing to the atmospheric air (which is still retained or imprisoned in the pores of the filament) becoming available for combustion the outer coating of carbon of such filament slowly combines with the same, and the CO vapors thus formed deposit on the inner surface of the glass bulb, which acts in the fashion of a condenser. In order to render serviceable again an electric incandescent lamp which has reached the above described stage, it is therefore indispensable, first, to free the bulb of such carbon deposit, and, secondly, to redeposit carbon on the partly burned or spent filament. The object of the invention patented by Mr. Fanta is to accomplish both these operations without removing the filament from the lamp, and consequently without interfering with the bulb, seal, or the capping of the lamp. For carrying out the invention he first of all removes or cuts away the small protruding point of glass formed on the bulb of the lamp as originally made when the tube by which the vacuum has been made therein is removed by means of the blowpipe, and he fixes onto the bulb, instead of the point just broken off, a small glass tube from four to six inches long. He thereafter heats the bulb outwardly and, preferably, locally by a flame applied successively over the surface to such a degree as may be necessary to burn the carbon deposited on its inner surface, and this operation is facilitated and rendered practicable at temperatures not injurious to the integrity of the glass and the preservation of the capping and the filament by causing previously heated air to circulate freely in the bulb while simultaneously drawing off the gases resulting from the combustion by means of a pump or of any other aspirating apparatus. The tube of the globe, which he uses for the above purpose, is fixed gas-tight by a stuffing-box and gland in a casing and carries an inner tube, the extremity of which is long enough to reach the part of the bulb diametrically opposite to the portion of the bulb into which the outer tube is jointed. The inner tube, which is also fixed gas-tight in a lower stuffing-box, is then used for the introduction of the atmospheric air from flange-openings controlled by a two-way cock, while the outer tube is connected to a pump through a side orifice, also controlled by a cock, and provides means for withdrawing the gases resulting from the combustion of the carbon deposit. After a short period of application of this cleansing process the glass of the bulb appears quite clear and free of the carbon. The bulb is now ready, and the process of depositing carbon on the filament can be proceeded with. For this purpose, having created as perfect a vacuum as possible in the bulb, he introduces into the bulb by mechanical circulation a gaseous hydrocarbon (as gasified liquid hydrocarbon or, more conveniently, purified coal-gas), with an admixture of a certain quantity of free atmospheric air, the proportion or percentage of which varies in accordance with the voltage and the candle-power of the filament and the condition of the vacuum in the lamp to be treated. He then passes the electric current through the filament. The introduction of the gaseous admixture can be effected by means of the above referred to inner tube by one of the alternative passages controlled by a two-way cock, and the withdrawal of the gases resulting from the slow combustion brought about by the incandescence of the filament, caused by the passage of the electric current, is effected by means of the pump through the side exit, the pressure of the gaseous mixture in the bulb being carefully regulated and maintained by means of adequate pressure-regulating valves or other automatic devices, it being essential to the success of the process that such pressure be adjusted to the condition of the filament in relation to the voltage of current and the candle-power required from the filament, as also to the size of the containing-bulb. As a result of this process carbon deposits on the filament, and it is obvious that its resistance diminishes, while the candle-power increases. Since, on the other hand, the object is to restore the carbon filament to its original smaller resistance and higher candle-power, the operation is begun with a variable resistance inserted in the main regenerating circuit, and this resistance is gradually increased simultaneously with the deposit of carbon upon the filament to compensate for the increasing section and reduced resistance of the filament, and a photometer is used for the purpose of standardizing the required lighting efficiency of the reenforced filament in comparison with a standard lamp or source of light on a separate constant circuit and with a required voltage of current on the regenerating circuit, maintained at a constant calculated voltage by the variable resistances. The operation is stopped when the voltage and the candle-power indicated by the instruments have reached the desired point; *viz.*, when the resistance, and, consequently, the candle-power of the filament have been brought back to their former value in the original lamp or to a predetermined or required standardized value. When the process has been completed to this point, the bulb is exhausted and sealed in the usual well-known manner.



LAMP MANUFACTURE.

### The Metric System.

It is stated by United States Consul Haynes, of Rouen, France, that the metric system is to-day compulsory in 20 countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru and Venezuela. He advises American exporters in dealing with any of these countries to adopt the system.

### Proposed American Electrochemical Society.

A meeting was held on November 1 at the rooms of the Engineers' Club, in Philadelphia, to discuss the question of the advisability of organizing a national electrochemical society on the same general plans as the American Chemical Society and the American Institute of Electrical Engineers. Some twenty or thirty persons, from different parts of this country, who were thought to be interested in the subject of electrochemistry had been asked to be present or to express their views by letter. Among the communications received the majority, especially from the electrochemical industries, were in favor of the formation of such a society; the minority thought the time had not come yet for such a society, that the American Chemical Society and the American Institute of Electrical Engineers filled the needs, that there were already a number of other societies at which papers on this subject could be read, etc.

Those present included representatives from New York city, from the Cornell, Lehigh and Johns Hopkins universities, from the American Chemical Society, the American Institute of Electrical Engineers, the Franklin Institute, etc. Professor J. W. Richards, vice-president of the American Chemical Society, acted as chairman, and Carl Hering, past president of the American Institute of Electrical Engineers, as secretary. All those present were heartily in favor, the only doubt expressed was whether a sufficient number of members could be obtained to make such a society a success. A committee was appointed with Dr. Charles A. Doremus, of the College of the City of New York, as chairman, to canvass for members, and if seventy-five or over pledge themselves to join, the society will be formed. In that case certain committees which were appointed will arrange for holding a formal meeting at which the society will be founded, and papers read and discussed. Any one desiring to become a member is asked to communicate with Dr. Doremus at the above address.

It was furthermore decided to be the expression of those present that the name of the organization should be the American Electrochemical Society, that the dues should not exceed $5 per year, and that at first only a few meetings of a few days each should be held per year, and that they be held in different cities, as the society is to be a national one.

The fact that papers on the subject of electrochemistry are now scattered over a half dozen or more existing national societies, was thought to be in itself a very good reason for bringing them all together into one, where they could then be properly discussed, which is not now the case. Attention was also called to the fact that the annual electrochemical products of this country already amounted to nearly $100,000,000, which is far greater than in all the other countries combined. Germany, which comes next with $14,000,000, has a flourishing electrochemical society with about forty members in the United States. The bringing together of those engaged in the scientific and in the industrial phases of electrochemistry, was thought to be of great value.

### Automobile Exhibit in New York.

The second annual show of the Automobile Club of America was opened in Madison Square Garden, New York, on Saturday evening, November 2, and will continue during this week. Automobiles of all sizes, styles and colors are on exhibition. Nearly all the foremost manufacturers of automobiles throughout the United States are represented.

Several different kinds of power are used, foremost among which are gasoline motors, electric motors and steam engines.

One of the most notable features is one of the new iron-nickel storage cells invented by Mr. Thomas A. Edison. It measures twelve inches in height, five inches in width and two inches in thickness. It is encased in steel and weighs seven pounds and six ounces. Its capacity is said to be one hundred and twenty watt-hours.

In the room at the right of the main entrance are a large number of machines loaned by different individuals. All these machines have an interesting history. Included among these machines are some of those first manufactured, as well as some of the most noted machines of the present day.

The number of exhibitors is large and there are many fine exhibits. The following companies are among the exhibitors:

American Bicycle Company, Toledo, Ohio; American Roller Bearing Company, Boston, Mass.; Baker Motor Vehicle Company, Cleveland, Ohio; Century Motor Vehicle Company, Syracuse, N.Y.; Crest Manufacturing Company, Cambridge, Mass.; De Dion-Bouton Motorette Company, Brooklyn, N. Y.; Dow Portable Electric Company, Boston; Electric Vehicle Company, Elizabethport, N. J.; Electric Contract Company, New York; Haynes-Apperson Company, Kokomo, Ind.; Hydra Double Battery Company, New York; Milwaukee Automobile Company, Milwaukee, Wis.; New Process Rawhide Company, Syracuse, N. Y.; Ohio Automobile Company, Warren, Ohio; Olds Motor Works, Detroit, Mich.; Porter Battery Company, Chicago; Searchmont Motor Company, Philadelphia; Shelby Steel Tube Company, New York; Upton Machine Company, New York; Ward Leonard Electric Company, Bronxville, N. Y.

### Common Battery Telephone System Installed at Cortlandt Street.

The great Cortlandt street exchange of the New York Telephone Company was successfully changed over to the common battery system Saturday evening, November 2, at 8.30 o'clock, in the presence of a number of invited guests.

A new switchboard for about 8,000 stations on the common battery system had been erected in a large room on the top story of the building at 25 Cortlandt street, a new story having been added to the building for its reception. At the hour set for the final change the few operators remaining at the old board left it and took their places at the new one, the change being made without an instant's delay to service.

The Cortlandt street exchange is one of the largest in the world, and is probably the busiest. Only those engaged in telephone work can properly appreciate the labor involved in changing this system or the ability shown in making such a change without interruption to service. The credit for this brilliant piece of work belongs to Mr. John J. Carty, chief engineer of the company and the inventor of the common battery system, and his corps of assistants. The whole service of the New York Telephone Company is now on the common battery basis.

### Goltz Engineering Company and F. B. Badt and Company.

Mr. F. B. Badt has sold his interest in the Badt-Goltz Engineering Company, Chicago, to Mr. William Goltz, who will hereafter control the affairs of the firm under the title of the Goltz Engineering Company. The following agencies will be retained by the new company: Zimdars & Hunt, Reuterdahl Electric Company, Charles J. Bogue, A. & W. Electric Sign Company, A. L. Ide & Sons (for Wisconsin), New Britain Machine Company.

Mr. Badt will continue in business under the name of F. B. Badt & Company, and will retain agencies for the Weston Electrical Instrument Company, Ward Leonard Electric Company and Harold P. Brown. The offices of both concerns will remain for the present in the Monadnock Block, Chicago.

### A New Line of Universal Enclosed Motors.

The rapidly extending field of the electric motor has given rise to a demand for a class of machinery that will readily lend itself to the unusual and widely varying conditions that are continually presenting themselves to the electrical engineer.

The Holtzer-Cabot Electric Company, of Boston, Mass., has recently placed upon the market a line of universal enclosed motors, designed more particularly to meet these special requirements. They range in size from one-sixth horse-power to ten horse-power, are simple, compact and easily adaptable to wall or ceiling suspension. This is accomplished by giving the end cases which hold the ring a quarter or half turn, as the case may be.

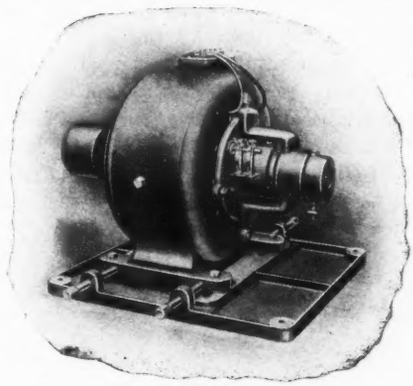
Up to and including the three-horse-power size, the machines are bipolar, and above that multipolar. It has been proven by experiment and careful calculation that in these smaller sizes the bipolar field is fully as efficient as the multipolar, while a machine with the bipolar field is, of course, much simpler in every respect.

The field frame is of cast iron and is circular in shape, as shown in the accompanying illustration. Thus the magnetic circuits are of equal cross-section and equal length, therefore necessarily of equal reluctance, so that there is no unbalancing of the armature circuits, a difficulty arising in most forms of bipolar field.

In the enclosed motor there is, of course, little or no chance for radiation from the inner portions of the machine. It is, therefore, of great importance that all electrical or magnetic losses be reduced to a minimum. Both armature core and pole-pieces are therefore carefully laminated to break up metallic continuity and to reduce the iron losses as much as possible. By careful copper allowances in the conducting portions of the machines the losses due to heating effects of the current are kept well within the limits of safety. The manufacturers claim an unusually low temperature elevation for machines of this type.

The poles fit into curved seats in the field ring, where they are held by bolts extending through the ring. They are built up of laminations of soft sheet steel and are provided with projections or shoes of such a shape as to form a properly shaped magnetic fringe. Shifting of the diameter of commutation is done away with and sparkless commutation secured through all changes of load.

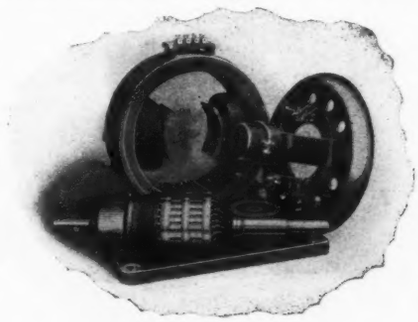
The armature is also built up of laminations of annealed steel; it is of the slotted type and the coils are held in place and protected from mechanical injury by maple wedges which run the entire length of the slot. It will be noted that the rocker arm is entirely dispensed with and the brushes are held by a ring which fits snugly into a machined seat in the front end case. This may be moved in either



UNIVERSAL SERVICE ENCLOSED MOTOR.

direction to place the brushes at the proper commutating point, being then clamped by two special screws.

The terminal board is placed conveniently on top of the machine, two special bosses being provided for that purpose. The connections are all made on the inside and are thus entirely out of the way, although they may be reached easily if necessary by slipping off the front end case. The commutator and brushes may be cleaned or adjusted without danger or inconvenience to the attendant. The brush-holders of the larger sizes are of the



MOTOR DISASSEMBLED.

standard radial type and are the same as used on the Holtzer-Cabot multipolar machines of the open-frame type. The brushes themselves are clamped solidly to a machined surface on the holders which are reenforced by a number of flexible copper strips, so that no springs nor sliding contacts are depended on to carry current. On the smaller sizes, where the motors are likely to be run a considerable length of time without attention, a box brush-holder is used with a parallel feed, which will allow a long period of wear without any attention.

These motors may be readily modified to meet almost all the conditions that arise in engineering practice. For buffing, grinding or polishing, or in cases where a motor is apt to be exposed to an unusual amount of dust and dirt a housing is fitted over the commutator, completely enclosing the motor. For electric launches, where minimum weight is desired, the non-metallic or non-conducting portions of the machine are made of aluminum. The motors are readily adapted for direct connection to fans, blowers, presses, etc.

The manufacturers claim unusually high efficiency for units of this size, varying from sixty-three per cent in the smallest to eighty-nine per cent in the larger sizes, with a relatively high efficiency on light loads.

### Disincrustation of Boilers.

The following translation of an article which recently appeared in *Revista Minera Metalurgica y de Ingeneria*, of Madrid, the leading journal of its kind in Spain, as of possible interest to our manufacturers and engineers, was sent by United States Consul Ridgely, of Malaga: The use of zinc to prevent the oxidation of the iron and the incrustation in steam boilers has greatly increased during recent years.

Heretofore, zinc has been employed for this purpose only in the shape of raw pigs, but after many experiments made by the society of "Mines et Fonderies de Zinc de la Vieille Montagne," which have since been confirmed by the British Admiralty, by the national French marine, and many great maritime companies, it has been established that compressed laminated zinc made in the form of thick plates for application as an inside boiler lining is greatly superior to the old method. In fact, the galvanic current developed transforms the pig of raw zinc into a more porous substance, in which the metallic molecules are isolated one from the other by the corrosion which is quickly produced, resulting in this, that the intimate metallic contact, which causes the generation of the electric current, is eliminated. Compressed laminated zinc, on the contrary, resists the spongy internal corrosion, as it corrodes only on the surface, thus being very slowly consumed and being capable of conducting the current as long as a metallic nucleus remains. The application of the laminated plates is very simple. They are applied to the walls of the boilers by means of strips and are so distributed that the galvanic action is exercised in an even way, when possible, over the entire surface of the iron. When oxidation is produced in any part of the boiler, it is because the nearest zinc plate is too far away. By this employment of pressed zinc the incrustation of the boilers is avoided, and at small cost.

# Views, News and Interviews

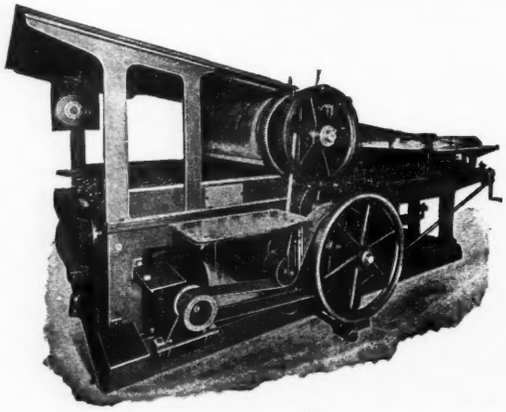
The other day the United States Pension Bureau granted a man a pension for service disabilities on the evidence of X-rays, the first time that such evidence has been allowed. A radiograph of the applicant's hands was used in pressing his claim.

During last year a steam log hauler was used by the backwoodsmen of the Dead River region, in Maine, to haul logs over the rough roads there. During the coming winter the steam roller is to have a companion—a still more wonderful machine—operated by electricity. The use of the steam roller presented so many advantages over the old forms of hauling logs that it was decided to make a further experiment and construct a machine operated by electricity. This machine is to have more power than the steam one, but less weight. A power station is being erected on the Aider Stream, where there is a good waterfall. A trolley wire will be strung along the trees that line the logging road. When all has been prepared, the electric hauler will be sent in and it is said that it is the confident expectation of all that the steam hauler will be beaten to a standstill.

It is stated that the new system of aerial telegraphy from automobiles, which was designed by Mr. Marconi, has been successful during the last military manœuvres in England. Two automobiles are provided with a mast and carry the necessary instruments for aerial telegraphy. In this way they may communicate at considerable distances. A steam omnibus of the Thornycroft pattern is the vehicle employed. It weighs five tons and develops an average speed of ten to fifteen miles an hour. An insulated metal cylinder is used to mount the mast wires. This cylinder is supported on the roof of the vehicle toward the front. When not in use the cylinder, which is about two or three feet high, can be folded down, thus it is possible to telegraph between the automobiles while they are in motion, which has already been done successfully. At a maximum distance of twenty miles it is said that messages can be received, but Mr. Marconi claims that this distance can be considerably increased.

Animal intestines, especially of the sheep and hog, have been found by C. L. Woods to offer a very convenient and perfect insulation of electric wires. The intestines are cleansed and wound around the wires so that the edges overlap, and as the material dries it forms a very close, firm and continuous coating. This coating may be overlaid with cotton, silk, shellac, coloring matter or vulcanite.

By the method proposed by Mr. Friese-Greene, of England, electrolytic printing would substitute for printer's ink an impression resulting from the combination of an electric current and suitable chemicals in the paper. The same processes and type now employed would be used, but with the type connected to the negative pole of some source of electricity and the pressure rollers connected to the positive. By the use of nitrate of silver it is figured by the inventor that he could print an eight-page newspaper with an expenditure of 1.134 grains of silver. A cheaper and efficient compound is manganese sulphate and nitrate of soda.



Belted Electric Motor-Driven Printing-Press Equipment.

A committee of the Franklin Institute on the use of granite as an insulator for electrical purposes has made its report, which has been published. Granite chips are calcined and powdered feldspar and kaolin added with water to make a plastic mixture. After the molded objects are heated to 3,000 degrees Fahrenheit they are glazed. Seventy-six-hundredths per cent of water in a year is absorbed by the product. It crushed at 7,000 pounds pressure per square inch, and showed a tensile strength of 900 pounds per square inch. The size of a sample was not stated, which has an insulation resistance of eight megohms.

## A MODERN PRINTING-PRESS EQUIPMENT.

BY H. M. DAVIS.

Electrically driven printing-presses have been in operation long enough to demonstrate beyond question their superiority over all other kinds. They are no longer an experiment, but are considered an important factor in economy of power and an increased output. The individual equipment of each press is also conceded to be the most satisfactory, but it is sometimes a question which method—belted, geared or direct-connected—gives the best results. One of the most successful is a belted equipment recently perfected by the Sprague Electric Company, and shown in the accompanying illustration. It consists of a Lundell four-horse-power, standard-speed, compound-wound motor, belted to a flat-bed press.

The motor is controlled by one of the Sprague company's standard rheostatic rotary controllers used in connection with armature and shunt field regulating resistances. The pulley on the motor is four and one-half-inch diameter and six-inch face, and the pulley on the main driving shaft of the press is twenty-two inches in diameter, six-inch face. The transmission of the power from the motor to the press is obtained with a medium thickness perforated endless belt five and one-half inches wide, which ensures noiseless operation and reduces slippage to a minimum. An idler or belt tightener is used which, together with the motor brackets, is furnished and attached by the press manufacturer. This method of equipment has merit, owing to the impossibility of sudden strains being put on the gears of the press or the motor by the rapid manipulation of the controller. With this equipment, if the controller suddenly throws the full power upon the motor, it causes a slight slippage of the belt until the press has attained its speed.

The motor is attached to a removable bed-plate which permits the motor, in case of accident, to be withdrawn and another substituted while repairs are being made. This equipment has the additional advantage of being an economical installation.

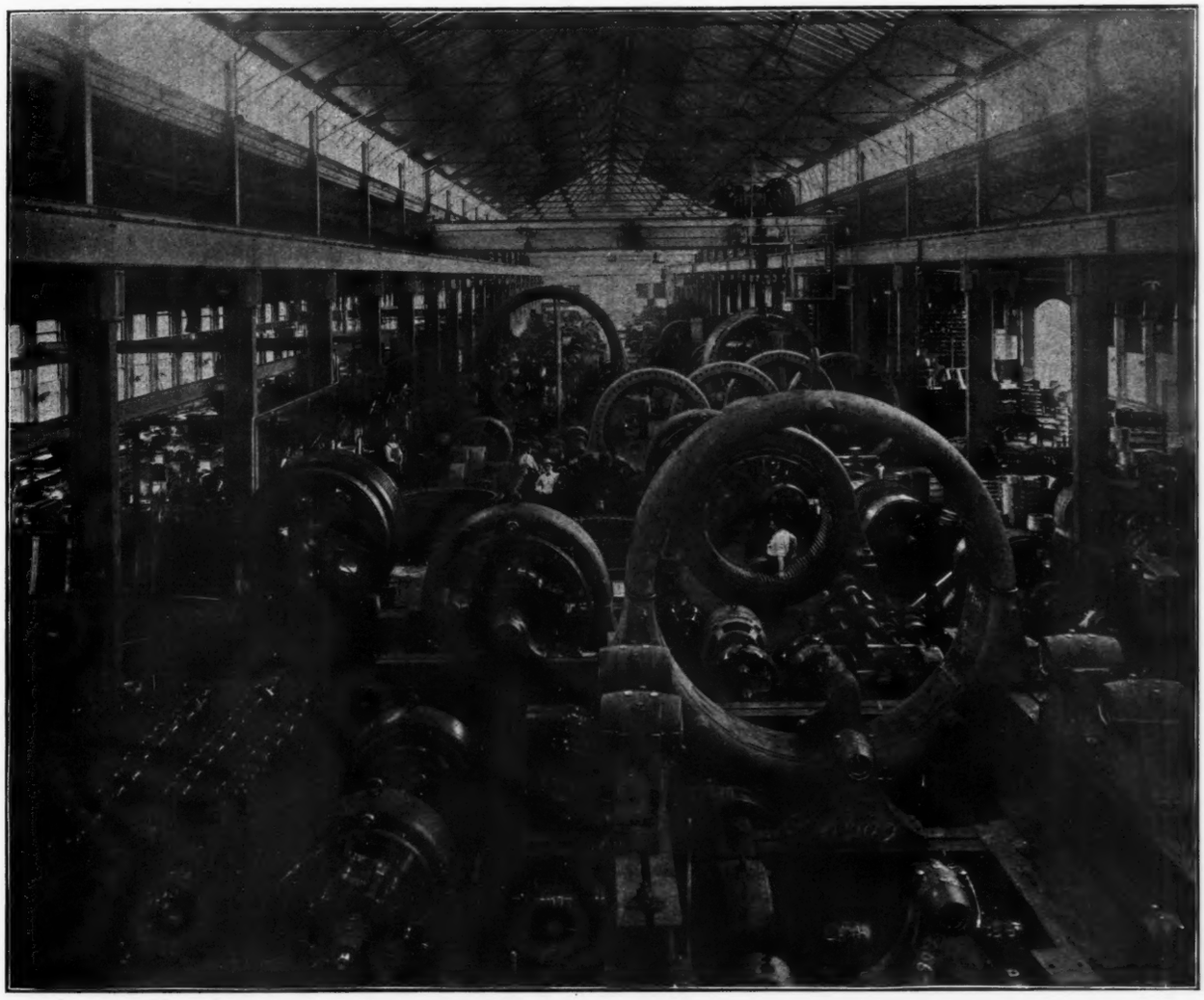
### Sulphuric Acid Concentrated Electrolytically.

It is said that sulphuric acid may be satisfactorily concentrated by heating it electrically. In some experiments a platinum wire 0.2 inch diameter was employed as the heater, and it was raised to a temperature of 480 degrees Fahrenheit. To make sixty-two pounds of concentrated acid required about forty-four horse-power-hours.

### The Large Machine Shop of the Bullock Electric Manufacturing Company.

The fine illustration on this page shows the interior of the main machine shop of the Bullock Electric Manufacturing Company works at Cincinnati, Ohio. The works are situated in the suburb of East Norwood, on a plot comprising about twelve acres, the various buildings being constructed of pressed brick, with steel trusses and skylights of translucent fabric. The power for operating the works is generated in a power-house wherein are installed several units of 100-kilowatt multiple generators made by the Bullock company. These machines have two commutators each and supply current at 44, 56, 66 and 84 volts, by which speed regulation of the various machine tools is accomplished. As will be seen from the illustration the machine tools are very often brought to the work by means of the traveling crane and are so grouped as to secure high efficiency and concentrated output. The entire absence of belts in this fine shop is very noticeable.

These works represent a number of modern ideas in machine works, construction and operation carried to their limit. Great care is taken to secure the convenience of employés, the company maintaining lunch rooms, reading rooms, individual lockers, shower baths, etc., for their benefit. The illustration of the main shop gives an excellent and comprehensive idea of the size and character of the work now under construction by the Bullock company, although none of the large alternators they are now building is shown in it.



One of the Main Aisles of the Bullock Electric Company's Factory, Cincinnati, Ohio.

Information has been published in the *Oesterreichisches Handels-Journal* that the Vienna-Pressburg line is to be constructed within the very near future. The preliminary work has been completed, and the representatives of the government are at present arranging the final details regarding the use of the bridge across the Danube, and the work to be done at the Hungarian end of the line, with Messrs. Siemens & Halske, who have obtained the contract.

### Telephone Time Indicator.

An ingenious device for measuring the actual time a telephone has been used so that the company may charge the subscriber only for the actual service he has had is the subject of a patent lately granted to Mr. Thomas Baret, of Sydney, New South Wales. The idea, of course, is that a subscriber who has but little use for his telephone will not be compelled to pay the same as one whose instrument is in fairly constant use. To this end the lever switch of the telephone is connected with the clock or other mechanism, which shall be inoperative when the telephone is not in use; but as soon as the receiver is lifted from the hook the clockwork shall commence to operate, and will thus register the extent of time that the instrument has been working. The apparatus is so arranged that the up-and-down movement of the lever switch shall wind up the clockwork, and thus the operation will be almost entirely automatic. A dial is provided for indicating the length of time the telephone has been in use.

### Some Modern Lamp Fixtures.

Every one who has occasion to work at a desk in the evening or who is occupied at any close work will appreciate the value of improvements in electric lighting facilities. Below a number of valuable adjuncts to the electric lights now in ordinary use are described, which will be found advantageous to many who use such lights.

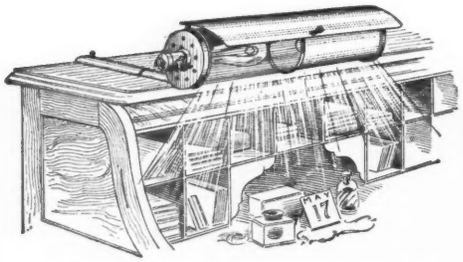


FIG. 1.—DOUBLE-CYLINDER DESK LAMP.

In Fig. 1 a double-cylinder desk lamp is shown. The eye shade, which serves as a reflector, way be moved by a touch to any desired position so that the desk alone may be illuminated or an illumination a short distance from the desk obtained. The inner glass cylinder has one clear surface and one of ground glass to soften the light if desired. This may be turned by a knob at the further side. There is an adjustable arm to enable the light to be drawn forward or pushed back at pleasure. All these changes may be made readily and without rising from one's chair. The fixture may be clamped to the desk without marring it. In this lamp a double-width cylinder to take two incandescent lamps for large illumination is used.

FIG. 2.—DOUBLE-CYLINDER PORTABLE LAMP.

Fig. 2 shows a double-cylinder portable lamp which has a double-width cylinder for the purpose of taking two lamps to furnish a greater illumination. These lamps are finished in nickle plate, polished brass, oxidized copper or old brass. They may be used as large as thirty-two candle-power.

A double-head portable lamp is shown in Fig. 3. The upper portion of this lamp is made the same as the desk lamps. This lamp has two heads, each of which takes one lamp for use on double flat-top desks where both sides are used. This lamp also is finished in nickle plate, polished brass, oxidized copper or old brass.

FIG. 3.—DOUBLE-HEAD PORTABLE LAMP.

The illustration designated as Fig. 4 shows a portable lamp for use on pianos, desks or any place where an elevated portable lamp is required. This lamp is finished of the same materials as those previously described.

FIG. 4.—PORTABLE LAMP.

FIG. 5.—ORCHESTRA LAMP.

An orchestra lamp is depicted in Fig. 5. This lamp is used for lighting orchestra music, etc. It can be readily clamped to music racks, is adjustable as regards the size of the opening which controls the quantity of light. The cylinder may be moved in a rotary direction to throw the light wherever desired.

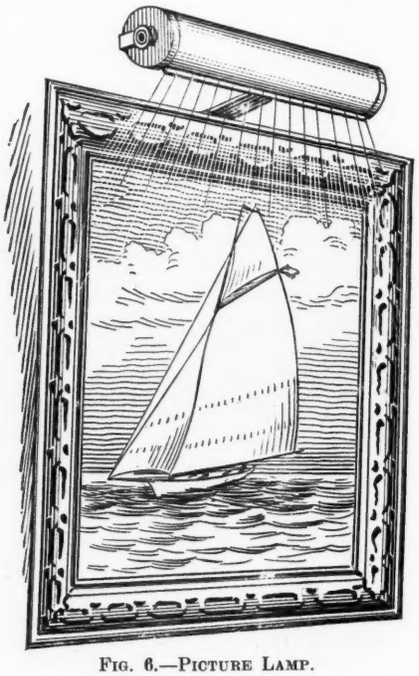


FIG. 6.—PICTURE LAMP.

In Fig. 6 a picture lamp is shown, which is used extensively for lighting fine oil paintings. This light may be regulated as to quantity and it may also be thrown on the exact place desired. It can be easily fastened to the back of a picture frame. It is provided with an adjustable supporting arm.

In Fig. 7 a pulpit lamp is depicted.

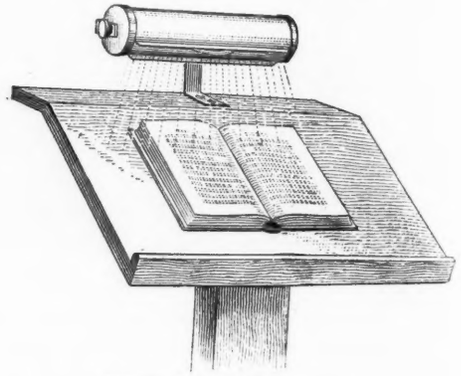


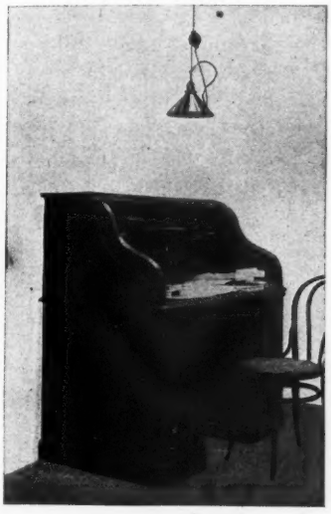
FIG. 7.—PULPIT LAMP.

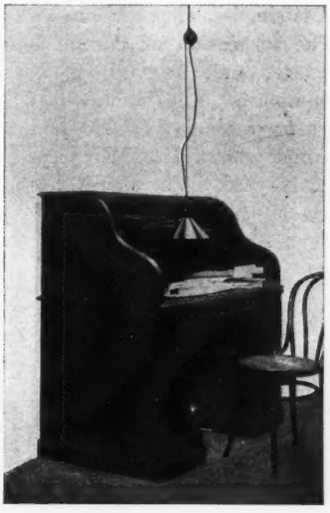
This lamp can be easily arranged on a pulpit to throw the light wherever desired without allowing any light to escape. It is said that this lamp is being used at present in many of the leading churches.

This series of lamps is manufactured by McLeod, Ward & Company, of New York.

### Incandescent Electric Light Manipulators.

Every manufacturer appreciates the fact that he obtains much better work when his employés work with a good light than when they work with a poor one. In this article a number of useful lamp appliances are described. By the use of the incandescent lamp cord adjuster the light from the lamp can be cast where it is most needed, and the lamp is out of the way when not in use. In Figs. 1 and 2 this cord is shown when used for adjusting lamps over a desk. It enables one to raise and lower a suspended lamp with one hand without climbing up. The case is very durable, which obviates to a large degree the risk of starting a fire. It can be attached in a minute and operated very readily in a minimum amount of time. This adjuster is said to be a perfect non-conductor and to be approved by all insurance and electrical experts. In Fig. 3 the adjuster is shown attached to a lamp for use in a machine shop.





FIGS 1 AND 2.—LAMP CORD ADJUSTER.

An incandescent electric lamp replacer and bulb cleaner is depicted in Fig. 4. By using this, bulbs of any candle-power of standard make at any height or angle can be cleaned without removing from the socket, which does away with long extension and special ladders, staging, etc., and prevents all risk of accidents. These manipulators and cleaners are made in two styles. One is suitable for street lamps or any lamps that can be handled by straight reach. Another is suitable for handling lamps which hang at an angle and is useful for halls, churches, theatres and public buildings. Both styles are made of very light gauge steel or aluminum tubing. These manipulators are manufactured by the Incandescent Electric Light Manipulator Company, of Boston, Mass., to whom was awarded bronze medals at Paris and Pan-American Fairs.

FIG. 4.—INCANDESCENT ELECTRIC LAMP REPLACER AND BULB CLEANER.

FIG. 3.—MACHINE SHOP LAMP.

### A New Flexible Conduit.

There has just been placed upon the market a new variety of flexible conduit which will be known under the trade name of "Flexduct." This product possesses several interesting novelties of construction.

The conduit is made of a continuous woven inseparable tube, made on a machine of special design, of a moisture-proof insulating fibre. The fibre is woven with its strands running lengthwise of the conduit and the warp threads alternately passing over and under it, thus making a structure which can not be unwound from a cut end, and making the tube of practically one piece with a smooth inside surface. Outside of this flexible fibrous tube is woven a cotton covering which is duly saturated with insulating compound. The fibrous interior of the tube is also filled with a special compound of high insulating quality, thus ensuring an extreme insulation resistance between the wire containing the conduit and any external object.

In case, in pulling a wire through this conduit, any sharp edge should catch in the inner weaving, the direction of the fibre being longitudinal and parallel with the axis of the conduit permits it to pass without ripping or tearing, and even in case of mechanical injury to the inside no particular harm is done, as the inside of the conduit is non-detachable. The interweaving makes it mechanically strong, and it is not possible for a careless or hurried workman to enlarge the size of the conduit by pulling out its interior lining. A large factory has been erected by the makers of this conduit, the Osburn Flexible Conduit Company, at Hoboken, N. J., and the company is now prepared to turn out large quantities of this product.

LAMP TESTING AMPERE-METER.

### A Lamp Ampere-Meter.

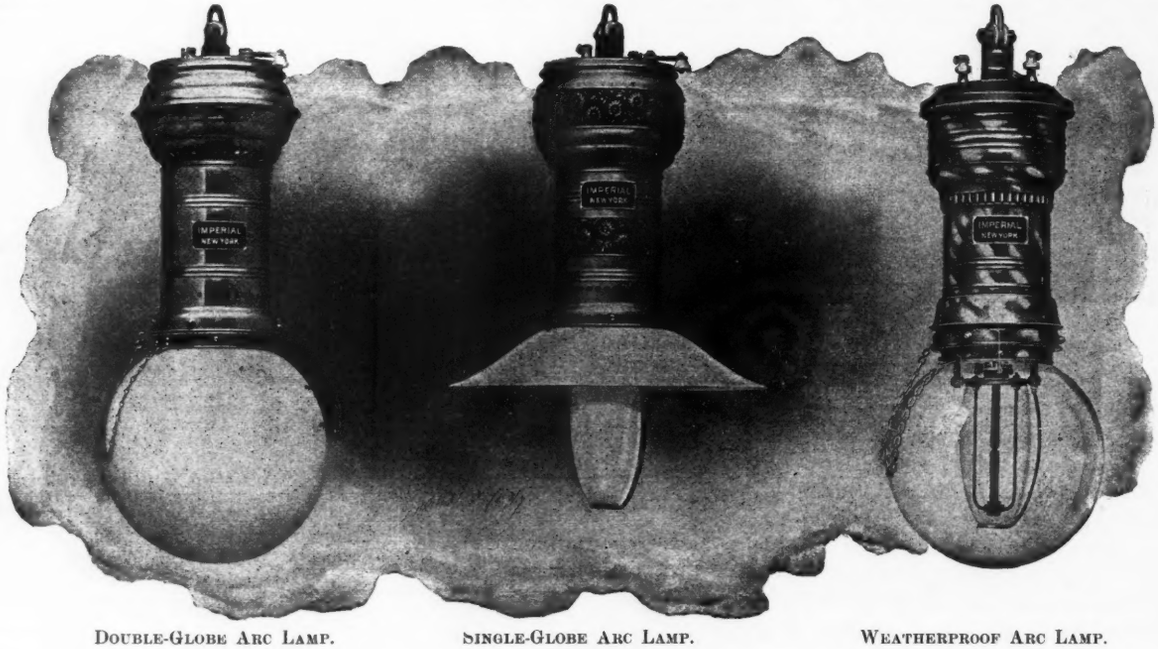
One of the most important tests which can be made by a central station is that of the new lamps received by it, in order to check their current consumption when burning at rated voltage. The apparatus illustrated in the accompanying engraving is a lamp ampere-meter made to compare lamps in this way and fitted so as to receive those having either Edison or T.-H. bases. The ampere-meter reads up to two and one-half amperes with graduations reading in tenths of an ampere and easily capable of estimation to one-one hundredth ampere. The little apparatus is very compact and has already been put into use in a large number of stations. It is manufactured by the L. E. Knott Apparatus Company, Boston, Mass.

### Rochester Gas and Electric Company.

Former Secretary of State Frederick Cook has been elected president of the Rochester Gas and Electric Company in place of the late J. Lee Judson. Mr. Charles B. Judson was elected first vice-president, and Mr. Irwin R. Judson, a director. President Cook announced that the late President Judson's plans in the matter of the development of power in that city, and the storage and regulation of the entire water supply of the Genessee River watershed will be carried out in their entirety. Irwin R. Judson is a graduate of Yale and is fully conversant with all of his father's plans.

### Enclosed Arc Lamps.

Although only a few years have passed since the enclosed arc lamp may be said to have become a commercial possibility, its many advantages over the old style of open arc lamps have brought about a revolution in arc lighting methods. Under such conditions it is unnecessary to discuss the comparative merits of the two systems, the problem having now resolved itself into a question of the selection of, first, the type of enclosed arc lamp best suited to the conditions, and, second, the make of lamp which can be most thoroughly relied upon to do properly the work for which it is designed.




DOUBLE-GLOBE ARC LAMP. SINGLE-GLOBE ARC LAMP. WEATHERPROOF ARC LAMP.

In the illustration three styles of lamp made by the Imperial Electric Lamp Company for Mr. Edwin I. Williams, New York, are depicted. These lamps present several features of excellence. The improved lamp, while it does not differ radically from the first of these lamps placed on the market, has been improved mechanically in one or two minor points which further simplifies it. The design has been to make the lamp as simple as possible. It has not been done at the sacrifice of strength and durability, and particular care has been exercised to make both the frame and working parts as substantial as possible to ensure a minimum of repairs.

The frames and mechanism are identical in all types of these lamps with the exception of the series constant-current types. The main body piece is one solid casting and the frame of the lamp is entirely out of the circuit. The magnets of these lamps are wound of wire one size larger than is customarily the case, and a vulcabeston spool is used which greatly reduces the tendency to burn-outs. The wire in the reactance coil of the alternating-current lamps is larger than usual. By a patented method of suspension no bolts pass through the laminations of the reactance coil.

The action of the clutch, which is a triple toggle, is simple and positive in its working. The suspension of the inner and outer globes has also been so simplified that trimming is an operation which requires but a few seconds. The size and shape of the inner globe are different from those ordinarily used. The object has been to increase the radiating surface in connection with the minimum inference with the light obtained from a design of lower frame. The carbon dust is never burned into the glass of the large inner globe, but can be readily shaken or wiped out through the roomy top opening. The mechanism and frame are similar in all types and the four poles of casings are likewise interchangeable.

The outdoor lamp is supplied in oxidized copper or black enamel finish of the same design, which is said to be both perfectly water and weather-proof and yet possesses ample provision for proper ventilation. The other outdoor lamps are supplied with inner and outer globes, while for indoor use they may be had either with two globes or with inner globe and porcelain shade, which is desirable where an intense, rather than a diffused, light is required.

This lamp is made for all circuits, alternating or direct multiple, constant-current series, railway and power circuits, or for series alternating systems.

### Dynamos for Ignition Work.

The generator which is shown in the illustration is made to be used for gas or gasoline engine ignition. It is light and compact and is of the enclosed type. It weighs about twenty pounds. Owing to a patent construction of the fields a high rate of efficiency is obtained. The armature is only two inches in diameter and one-eigth inch long. At a speed of 1,500 revolutions per minute twelve volts and three amperes are developed in the type A machine, and six volts and six amperes in the type B machine.

The brushes are made up of alternate layers of corrugated copper and composition. They are self-lubricating and cleaning, which ensures long life to both brush and commutator. The bearings are of sufficient length and are of phosphor bronze with a self-lubricating device which requires very little attention. These generators are manufactured by A. C. Niemann & Company, Milwaukee, Wis.

DYNAMO FOR IGNITION WORK.

### Some New Direct-Current Power Transmission Machinery.

At the present time perhaps no phase of machinery operation is attracting so much attention as that of electric drive. Nearly all manufacturers recognize that it is possible in this manner to obtain a greater amount of economy, convenience and flexibility than by any other method. A very compact and workmanlike series of electric motors for driving machine tools and of generators for motor driving and lighting is manufactured by the Northern Electrical Manufacturing Company, of Madison, Wis.

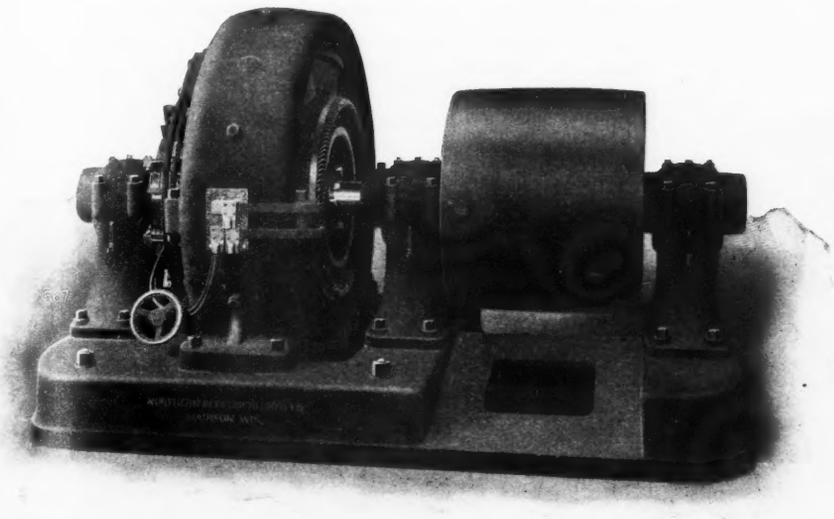


FIG. 1.—EIGHT-POLE BELTED-TYPE GENERATOR.

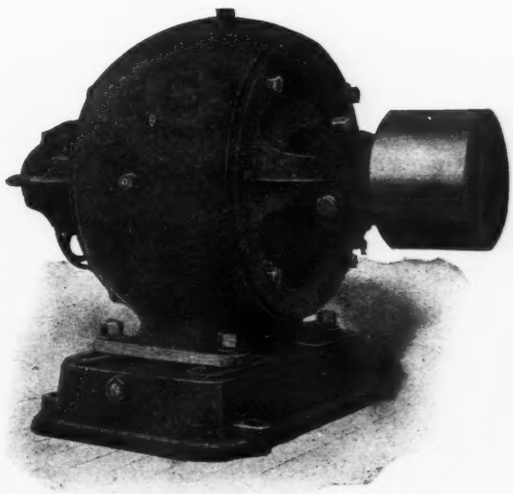


FIG. 2.—SPHERICAL MULTIPOLAR MOTOR.

In Fig. 1 an eight-pole belted-type generator with three bearings is shown, which exhibits a powerful and compact design and is convenient for many purposes. Great care is exercised in the construction of these dynamos, especially upon the machine work and bearings and to ensure a combination of mechanical strength and electrical efficiency.

The illustration, Fig. 2, shows a spherical multipolar motor. These motors are carefully designed and finished and are said to be highly efficient and economical in their working. They may be either belted, geared or direct-connected to the machine to be driven. The compact and symmetrical design of these motors makes them of great value where the space is restricted, or when it is desired to combine the motor and the driven machine so that no additional floor space is required.

They are constructed with bronze bearings and automatic oiling rings which make it possibl. to operate them either on the floor, ceiling, side-wall or on a post. They may be changed from one position to another by simply transposing one screw and the oil cock on the bearings. No change is made in the field terminals, and the risk of accident by such a change is thus avoided.

An eight-pole engine-type generator is illustrated in Fig. 3. These generators are constructed so as to give a high efficiency and meet the exacting conditions of the specifications and practice of the present day. Economy of space was sought in their design, which is both pleasing in appearance and mechanically strong. Their heavy brush-holders and large commutators give these machines long life and excellent wearing qualities.

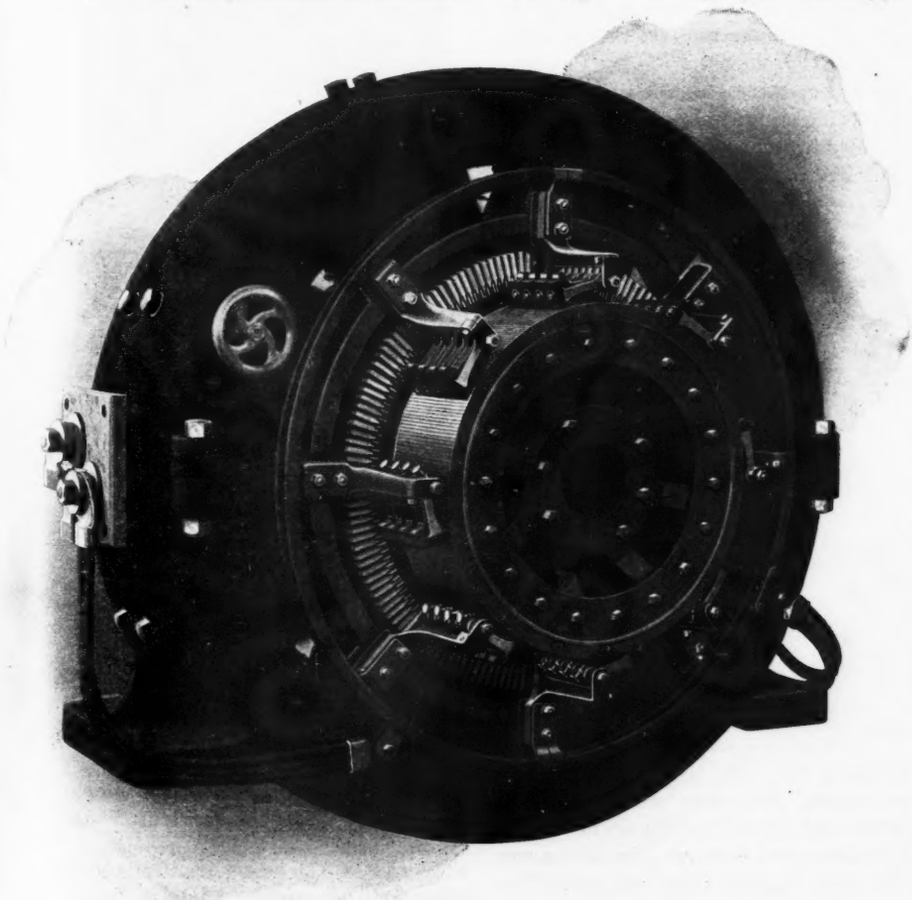


FIG. 3.—EIGHT-POLE ENGINE-TYPE GENERATOR.

### Fire-Detecting Wire.

Any one who has had experience in the handling of high-tension electric currents appreciates the fact that it is necessary to adopt the greatest possible precautions to prevent serious fires. In some cases, by defective insulation or other causes, serious fires have taken place which have resulted in great loss of property and frequently in the loss of human life.

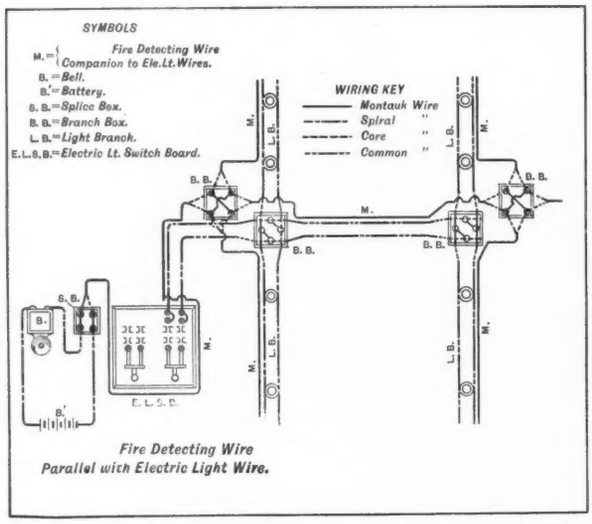



FIG. 1.—FIRE-DETECTING WIRE PARALLEL TO HIGH-POTENTIAL WIRE.

The arrangement of apparatus shown in Fig. 1, in connection with a fire-detecting wire of peculiar construction, has for its object the notification of those in charge as quickly as possible when a fire takes place. This wire, which is manufactured by the Montauk Fire-Detecting Wire Company, of New York, is intended to give the alarm as soon as there is any danger of fire. The method of construction to be ordinarily adopted in wiring buildings for electric lights is to lay this fire-detecting wire parallel with the wire which carries the current. In case of an arc being formed, the detective wire would be burned almost instantly and thus give the alarm of fire in time to prevent serious damage. It would seem that the insurance companies should not be slow to recognize the value of such a protecting wire in buildings where high-potential currents are carried by the lighting installations.

In Fig. 2 some branch and splice boxes made by this company are shown. By an inspection of the illustrations it is easy to see the purpose for which they are intended. By the use of box A various branches can be extended, while the supply box marked C enables the electrician to install a wire in various lengths and to connect with ordinary bell wire.

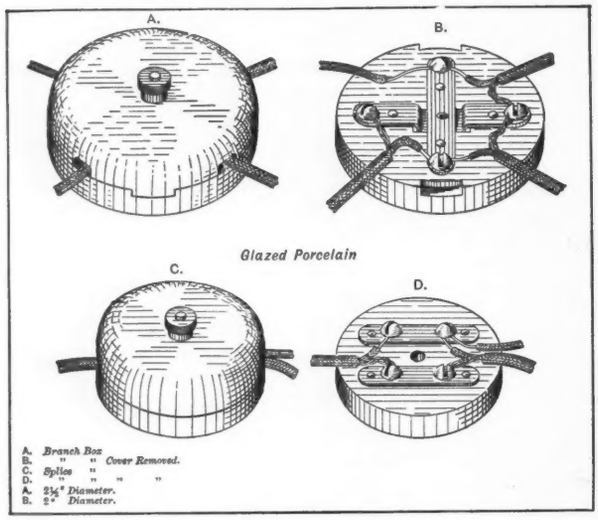


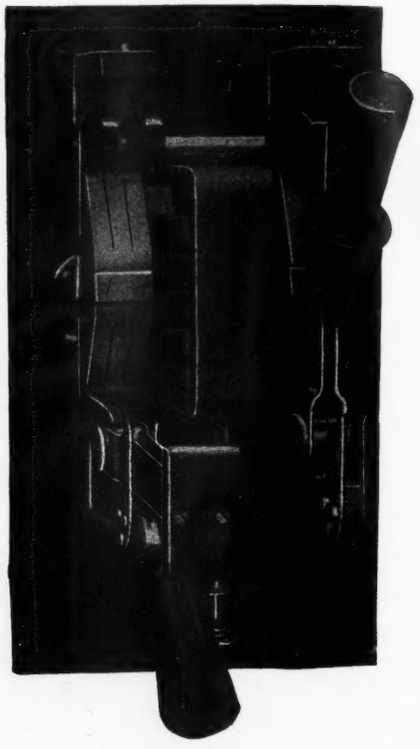

FIG. 2.—BRANCH AND SPLICE BOXES.

### Electrical Developments in Korea

Mr. Horace N. Allen, United States minister at Seoul, writes as follows regarding the above subject: On the night of August 17, the Seoul Electric Company formally opened its electric lighting plant by turning on the power and illuminating the city by arc and incandescent lights. This lighting plant is run in connection with the electric street railway, the installation being of the polyphase direct-current alternating-current system. I append a report on the plant from the contractors. The Seoul Electric Company is a Korean concern, but the builders and operators are American — Messrs. Collbran and Bostwitck — who hold the plant on mortgage until all indebtedness is paid. This is not the first electric plant to be erected in Korea. In 1886 an Edison incandescent plant was installed in the palace, and was successfully operated until the boilers were worn out. In 1894 a new and very complete plant was erected by the American electrician of the Korean Government, Thomas W. Power, but the advent of the Japan-China war prevented its use for more than a short experimental period.

### A New Circuit-Breaker.

A central station manager, thoroughly interested in the success and maintenance of his plant, realizes the depreciating effect of an overload on his generating apparatus, and any positive protecting device is eagerly sought and adopted, for he knows that on the excellence of the protective features of his system depends the continuity of his service.



A NEW DOUBLE-POLE CIRCUIT-BREAKER.

A circuit-breaker of positive action gives constant protection to a generator and thus prevents the attendant expense and loss of earning power in case it were injured.

The circuit-breaker shown above, manufactured by the G. I. Arc Light Company, of New York city, is said to be very efficient and to meet the conditions described above.

It has many excellent features, is neat in appearance, simple in design and is fitted to take a place in the electrical trades as a reliable piece of apparatus.

Some interesting wireless telegraphy experiments, using the earth as a conductor, have been made recently in England by Messrs. Armstrong and Orlong. The outcome of these experiments is being watched with interest by electricians.

# CURRENT ELECTRICAL NEWS

## COMMERCIAL NEWS

### DOMESTIC AND EXPORT

RAILWAYS CHANGE HANDS—News comes from Denver that the Colorado & Southern Railway has purchased the Denver Tramway Company and that the Interurban Electric Railway, to extend to Idaho Springs and other places, will be built.

NEW ROAD FOR AUTOMOBILES—In New York a macadam boulevard for the extensive use of automobiles is being constructed between Pelham avenue and the Kingsbridge road. This is to be called a motor road and is the first one planned by the city officials.

WIRELESS TELEGRAPHY—Cruisers connected with the channel squadron were stationed 100 miles apart in the English Channel and out to sea to send the first greeting of the Duke of Cornwall and York to King Edward and Queen Alexandra by wireless telegraphy.

MANITOBA POWER PLANT—The Manitoba Water Power and Electric Company, which was recently organized, has secured the lease of a water power on the Winnipeg River, sixty miles from Winnipeg. The company is preparing to put in an electric plant capable of producing 10,000 horse-power.

NEW AUTOMOBILE LINES IN BOSTON— In the use of electric vehicles for transportation of merchandise and passengers in Boston a new experiment is now being planned which it is expected will be started before the end of the year. It is said that the Armstrong Transfer Company is behind the undertaking.

RECEIVER FOR AUTOMOBILE CONCERN—Mr. Samuel F. Lever has been appointed receiver for the New Jersey Automobile Company, by Vice-Chancellor Stevens. The receiver was appointed on the application of Mr. Frederick C. Hodge, president of the company, who claims that the company is insolvent.

TELEPHONE LINE SHIFTED QUICKLY—The New England Telephone and Telegraph Company shifted its lines in Boston from the old board to the new one in one hour and five minutes. The work was carefully prepared for in advance and was carried out without a hitch. During the sixty-five minutes 6,000 connections were changed.

NEW POWER PLANT FOR NEW SOUTH WALES —At Windsor, New South Wales, a company has been organized to construct and operate an extensive water-power plant on the Colo River, which is about thirty miles from Windsor, for the purpose of generating electricity to supply Sydney, Newcastle and other cities in that locality.

ELECTRIC RAILROAD TO CONNECT MINES—Mr. Barney McCaffrey, of Cheyenne, Wy., states that his company intends to consolidate all of the large paying mines in the southern Carbon County country and connect them with the smelter at Grand Encampment by an electric railway system. It is estimated that the trolley system will cost about $3,000,000 to construct.

LARGE PLANT IN MEXICO—The work on the gas and power plant which is to be constructed at a cost of about $800,000 in Monterey, Mex., will soon be begun. Mr. R. N. Oakman, of New York, is interested and has gone to Mexico together with engineering experts to begin the work of construction. It is intended to furnish light and motive power to large and small manufacturing industries in Monterey and its suburbs.

LARGE POWER PLANT ON CONNECTICUT RIVER—A penstock to handle water from the Connecticut River at South Manchester, Ct., is being constructed by the Riter-Conley Company. A large electric power plant is to be erected which will drive the cotton mill machinery of the Manchester district. It is said that the equipment of the mills at Manchester, which are to use the new motive power, is being constructed in Pittsburgh.

ELECTRIC TRAIN LIGHTING—The Pullman Company has just finished and delivered to the Louisville & Nashville Railroad Company three elegant dining cars, equipped with the "axle light" system of the Consolidated Railway Electric Lighting and Equipment Company. No auxiliary light has been provided in these cars. One of these cars will run between Cincinnati and Louisville and two between Birmingham and New Orleans.

NEW ELECTRIC COMPANY IN SPAIN—The Societe Iberique Thomson-Houston is the title of a new concern registered in Madrid, with a capital of over $1,900,000 for the purpose of acquiring, working and exploiting the Thomson-Houston patents in Spain and Portugal, and also to acquire the tramway concession for Cadiz from the Societe Anonyme Thomson-Houston de la Mediterranee, which is a branch of the French Thomson-Houston Company.

LARGE ELECTRIC PLANT IN GEORGIA—Mr. George J. Baldwin, of Savannah, and his associates have secured a controlling interest in the Chattanooga Falls Company, of Columbus, which owns the Clapp factory falls property on the Chattanooga River, about two miles north of Columbus. Stone & Webster, of Boston, Mass., are said to be associated with Mr. Baldwin. It is said that an electric plant to develop 14,000 horsepower will be built in the near future.

SYSTEM OF ELECTRIC RAILWAYS IN KENTUCKY—Ex-Senator George B. Davis is said to be interested in a plan to establish a system of electric railways and railroad industries in Kentucky. For this purpose it is said that a capitalization of about $7,000,000 will be required. It is also stated that it is proposed to furnish not only transportation but to use the power plants to supply electric light and make artificial ice. Mr. Davis states that the necessary franchises have already been obtained. The name of the company to be formed will be the Blue Grass Rapid Transit Company.

LARGE POWER PLANT AT SAULT STE. MARIE, —Mr. F. H. Clerque, of Sault Ste. Marie, is said to have decided upon the construction of a large water-power canal to cost upward of $2,000,000. It is said that Messrs. Widener and Elkins, of Philadelphia, are interested in the enterprise. It is intended that the new canal will develop about 20,000 horse-power of electric energy from the rapids of the St. Mary's River opposite the ship canal. For this purpose the St. Mary's Falls Power Company was organized a short time ago. Application has now been made to the board of supervisors in accordance with the statute for permission to divert the waters of the river for this purpose.

DEVELOPMENTS IN TELEGRAPHY—A series of experiments has been carried on between Paris and Bordeaux with the telephone apparatus invented by M. Mercadier, one of the head masters of the Paris Polytechnic School. It is said that the operators had no difficulty in transmitting on the same wire sixteen messages at the same time and that they received messages from an equal number of operators without the slightest confusion. It is said that the success of the experiment has led M. Mougeot, director of the French Post and Telegraph Department, to establish the Mercadier apparatus immediately for the purpose of transmitting to Havre and Brest cablegrams for England and America.

## ELECTRIC LIGHTING

REDLINE, PA.—A new electric light plant is to be constructed.

BURLINGTON JUNCTION, MO.—An electric light plant is to be built at Burlington Junction.

SALEM, N. H.—Mr. Ernest P. Woodbury has begun work upon the new electric light plant.

LEESVILLE, LA.—The Leesville Electric Light Company has begun to operate its plant.

ALTOONA, PA.—A new electric light company is being organized by prominent local capitalists.

LAURIUM, MICH.—The construction of a municipal electric light plant is being agitated.

YORK, PA.—The Merchants' Electric Light, Heat and Power Company has nearly completed its new plant.

LEAMINGTON, MICH.—Mr. H. C. Ward is preparing to fit up his tobacco factory with an electric light plant.

TRAVERSE CITY, MICH.—An electric light plant for Mr. Victor Petertyl has just been installed by Campbell Brothers.

LOWELL, MASS.—The regular semi-annual dividend of two and one-half per cent has been declared by the Lowell Electric Light Corporation.

VERSAILLES, OHIO—For waterworks extension and electric light purposes an issue of bonds to the amount of $10,000 has been decided upon.

PLYMOUTH, PA.—Mr. Thomas West, who owns the Wyoming Knitting Mills, is adding an electric light plant to illuminate both the mill and his residence.

WHEELING, W. VA.—The Wheeling Steel and Iron Company is constructing a new electric light plant to be used in connection with its new tube works.

DUBLIN, GA.—The city council has recently employed an expert electrician to determine what was needed at the light and power plant in the matter of machinery.

GEORGETOWN, S. C.—A commission has been issued to the Georgetown Electric Company, which was formed for the purpose of lighting the city. The capital stock is $50,000.

PORTSMOUTH, N. H.—The Rockingham Light and Power Company has had its new plant exempted from taxation for a term of ten years by the city government of Portsmouth.

LEWISTON, ME.—The Lewiston Light Company has bought the American Light and Power Company, of Lewiston, Me. A consolidation of these two companies has been effected.

NEWPORT NEWS, VA.—A large electric plant is to be installed at Fortress Monroe which will be capable of lighting the works and also the entire fort both within and without.

GREENWOOD, IND.—The American Light and Water Company, of Indianapolis, Ind., has been granted a franchise for a combined water and lighting plant to be constructed in Greenwood.

ST. LOUIS, MO.—The St. Louis Electric Construction and Maintenance Company has leased the property of the Suburban Elec-

tric Light and Power Company for a term of forty-one years.

ST. PAUL, MINN.—The Imperial Manufacturing Company has been granted a franchise to furnish heat, light and power in the business section and a portion of the residence district of the city.

NORTH DIGHTON, MASS.—The building for the bleachery which is being constructed is to be lighted by electric light. A large dynamo has been put in by the company to furnish the power.

PORTLAND, ME.—The American Light and Power Company has sold its business to the Lewiston & Auburn Electric Light Company. A consolidation of these two companies has now been effected.

GREENSBORO, N. C.—Mr. A. J. Dunn has received the contract for the erection of the power-house of the Greensboro Electric Company. By the terms of the contract the work must be completed by January 1, 1902.

ENGLESIDE, PA.—Mr. George H. Oster has received the contract to make additions to the power plant at Engleside from the Lancaster County Railway and Light Company. The power-house is to be enlarged and 4,500 horse-power added.

CLEVELAND, OHIO—It is reported that the electric light, telephone, telegraph and other companies which have overhead wires in Cleveland will meet within a short time for the purpose of agreeing, if possible, upon some plan of placing all the wires underground.

SAN FRANCISCO, CAL.—Joseph McWilliams & Company, of Louisville, Ky., have been awarded the contract for installing the complete mechanical equipment, consisting of boilers, engines, electric light plant, elevators, etc., in the new Federal Building in San Francisco.

LITTLE ROCK, ARK.—Mr. Thomas W. Dixon, of the Fort Wayne Electric Works, has received a contract from the board of public affairs for the enlargement of the city electric light plant, so as to have a full capacity of 360 arc lamps. The contract amounts to about $20,000.

MEMPHIS, TENN.—The plant of the Memphis Light and Power Company has been remodeled. The expense of remodeling and building the conduit system amounts to about $600,000. The work is now nearly completed. These alterations make this plant one of the largest in the South.

EAST DUBUQUE, IOWA—The Union Electric Company has canvassed the city for incandescent light subscriptions and secured contracts for about 500 lights. With this assurance the company will string wires from Dubuque, the work for which will be begun in a short time.

NORWICH, CT.—The police commissioners have made arrangements with the Norwich Gas and Electric Company to discontinue the gasoline lights. Incandescent lamps are now to be installed. The Gas and Electric Company will expend about $5,000 in installing the new system.

ELBA, ALA.—A declaration of incorporation of the Elba Power Company has been filed in the probate office. The capital stock is $30,000, of which $25,000 has already been subscribed. The object of the corporation is to develop the water power in Elba for an electric light plant and manufacturing purposes.

REDWOOD CITY, CAL.—The city is now lighted by the electric current which is generated at Blue Lakes. The cable lines are owned by the Standard Electric Company, of California, while the Consolidated Light and Power Company acts as its distributing agent for the county of San Mateo. The later company now has the contract for lighting the streets of Redwood City and also the city of San Mateo.

## TELEPHONE AND TELEGRAPH

FORT SCOTT, KAN.—From Fort Scott by way of Piqua a telephone line is being built.

KIMBALL, S. D.—A telephone line between Kimball and Platte is being constructed.

EDNA, TEX.—A telephone company is being organized by Mr. W. M. McCrary and others.

LA CROSSE, WIS.—A telephone line is being built between La Crosse and St. Paul and Minneapolis.

LA SALLE, ILL.—The Borough County Telephone Company has increased its capital stock to $120,000.

STEUBENVILLE, OHIO—Extensive repairs are being made upon the telephone line between Steubenville and Richmond.

ROCK ISLAND, ILL.—The citizens of Rock Island have voted in favor of the Bills' independent telephone system.

MERIDIAN, MISS.—It is stated that the local telephone company has sold out to the Cumberland Telephone Company.

SALT LAKE CITY, UTAH—It has been arranged to connect the lines of the Opal and Big Piney telephone companies.

CHAMPAIGN, ILL.—Arrangements are being made to put in about 3,000 feet of new cable by the Home Telephone Company.

CARDIFF, ALA.—The Southern Bell Telephone Company has been granted franchises to construct a telephone line in Cardiff and Brookside.

WESTON, OHIO—The Weston-Grand Rapids Telephone Company is setting the poles to extend its lines into Liberty and Jackson townships.

CLAY CITY, IND.—Under a franchise granted two years ago the Central Union Telephone Company has begun putting in a system there.

BALLSTON SPA, N. Y.—A new switchboard is to be installed at the central office of the Hudson River Telephone Company at a cost of about $60,000.

DUNKIRK, N. Y.—News comes that the telephone company, which has recently been engaged in putting up a system, is about ready to begin operations.

SARATOGA, N. Y.—In the local central office of the Hudson River Telephone Company a new switchboard is to be installed at an expense of about $16,000.

OLEAN, N. Y.—The Union Telephone Company has been obliged to install an additional board for 100 more lines, owing to its rapidly increasing business.

NEW ORLEANS, LA.—The American Telephone and Telegraph Company is said to have bought the Texas Long-Distance Telephone Company for $35,000.

BATH, ME.—Linemen of the New England Telegraph and Telephone Company are rebuilding its lines between Bath and Popham and Bath and Waldoboro.

WICHITA, KAN.—The Missouri & Kansas Telephone Company and Mr. Frank L. Brown have applied for ordinances to control telephone systems there.

MINTONVILLE, KY.—From Mintonville to Humphrey a telephone line is being constructed. In Humphrey it will make connection with the Middleburg line.

CIRCLEVILLE, OHIO—The Citizens' Telephone Company has been compelled to enlarge its switchboard. A new section which recently arrived will soon be installed.

WINONA, MINN.—The Winona Telephone Company has purchased the toll lines and exchanges of the Phœnix Telephone Company, of Rushford, Minn., for about $15,000.

SALTILLO, TENN.—The Cumberland Telegraph and Telephone Company is placing poles between Saltillo and Swallow Bluff for the purpose of extending its line to that point.

NASHVILLE, TENN.—A contract to build twenty-four and one-half miles of telephone line to connect Nashville with Rogersville and Oliver has been closed with Mr. John A. Pruitt.

ST. MATTHEW, S. C.—The Orangeburg & St. Matthew Telephone Company has made application for a charter to connect St. Matthew *via* Orangeburg with the long-distance Bell telephone system.

EVANSVILLE, IND.—Two new telephone companies have applied for franchises from the board of public works. They are the Evansville Home Telephone Company and the Telephone Company of America.

FREDERICKSBURG, VA.—Plans are being considered for connecting the Spottsylvania and Louisville telephone lines which would put that section in direct connection with Richmond and other Virginia cities.

LOUISVILLE, KY.—The Louisville Home Telephone Company is being financed on a basis of $1,000,000 worth of bonds and $1,000,000 worth of common stock. All of the bonds has been subscribed for at par.

JOHNSTOWN, PA.—The construction of the new telephone line of the Huntington & Clearfield Telephone Company has begun. The company's line will be constructed between Carrolltown and Spangler.

IONA, MICH.—A franchise has been granted to the Citizens' Telephone Company, of Grand Rapids, for a new exchange. Work has been begun preparatory to putting in 30,000 feet of underground conduits.

SALINA, KAN.—Mr. A. Simons, who is the general foreman of the telegraph construction for the Union Pacific Railroad, is superintending the rebuilding of the telegraph system between Salina and Wamego.

CONNERSVILLE, IND.—The Cambridge City toll line has been purchased by the Connersville Telephone Company, which gives the subscribers of the Connersville company telephone communication with Cambridge City.

SALT LAKE CITY, UTAH—Mr. P. J. Lackner, of the Telluride Power Company, has petitioned the county commissioners for a franchise to construct a power and telephone line along the county road west of Jordan River.

EVERETT, MICH.—The lines of the Everett Citizens' Telephone Company have been extended to Temple, Mich., which gives the people of Temple connection with the state lines of the Independent telephone companies.

MOLINE, ILL.—The material for a farmers' telephone line to extend from the Moline exchange through South Moline township has been ordered by the Central Union Telephone Company. It is expected that the system will be in operation by January 1.

ABERDEEN, MINN.—An increase of the capital stock from $100,000 to $500,000, which was authorized by the stockholders, has been made by the Dakota Central Telephone Company. The new stock is to be issued as fast as needed for improvements and extensions.

JANESVILLE, WIS.—At a meeting of the stockholders of the Badger State Long-Distance Telephone Company it was decided to reorganize the company. A reorganization

committee is to be appointed by Chairman Twining.

PITTSBURGH, PA.—Mr. James F. Doyle, for the Pittsburgh & Allegheny Telephone Company, has signed a contract with the Union Telephone and Telegraph Company for long-distance services in the territories of the companies.

BEDFORD, IND.—The city council has granted a central office franchise to Mr. James Ruddick, who has erected a seventy-mile telephone system, which brings a number of towns of importance on its line into direct communication with Bedford.

PARKERSBURG, W. VA.—The Independent companies of central West Virginia have combined. The company will be known as the Central West Virginia Telephone Exchange. Mr. H. C. Henderson, of Parkersburg, has been elected president.

CARLISLE, PA.—All of the old officers of the Southern Pennsylvania Telephone Company have been reelected. The company is considering a proposition to consolidate with several other companies which govern lines in Franklin and Dauphin counties.

WHARTON, TEX.—Line Master Elkins, of the Southwest Telephone Company, is engaged with a force of men in putting up the poles and wires at this end for the Pittsburg & Glenflora telephone line, which is to connect with the central station in Wharton.

WICHITA, KAN.—Mr. Frank Brown has accepted the telephone franchise which was granted him by the city council. Mr. Brown announces that the name of the company will be the Wichita Telephone Company. It is stated that building operations will be begun at once.

HATTIESBURG, MISS.—The telephone exchange which Mr. T. M. Ferguson established four years ago and sold to Messrs. Collins & Sons, has been sold to a stock company, which was recently organized, for $7,500. Mr. A. U. Montgomery is the president of this company.

GALVESTON, TEX.—It is expected that the long-distance telephone line of the Citizens' Telephone Company, which is being constructed between Houston and Galveston, will soon be completed. This company has recently completed a line from Houston to Beaumont which it is now operating.

TOLEDO, OHIO—State Senator Brorein and others have organized the Auglaise Construction Company for the purpose of building and operating independent telephone lines through Ohio, Indiana and Illinois. It is said that work will be begun at once along some of the new interurban traction lines.

ROCHESTER, N. Y.—The American Telephone and Telegraph Company has secured practically all the consents from property owners for the erection of poles and the stringing of wires for its telephone line between Rochester and Syracuse and about half the work has already been completed.

SPOKANE, WASH.—The long-distance line between Peshaston and Cle-Elum, which the Pacific State Telephone and Telegraph Company has been constructing for several months, has been completed. The completion of this line gives the company two lines to the Pacific coast and greatly shortens the distance to Seattle and Tacoma.

NEW YORK, N. Y.—At the meeting of the stockholders of the Telephone, Telegraph and Cable Company of America, Messrs. H. E. Gawtry, George Crocker, William J. Latta and Frank Tilford were retired from the directorate of the Telephone, Telegraph and Cable Company of America, and Messrs. C. W. Morse, J. E. MacDonald, R. B. Moore, R. L. Edwards, J. T. Sprool and John T. Morse elected to take their places.

## ELECTRIC RAILWAYS

ROCHESTER, PA.—Work has been begun upon the North Rochester Electric Street Railway.

NEWCASTLE, ME.—An electric railway between Newcastle and Booth Bay Harbor is being agitated.

RICHMOND, VA.—A new railway up Little River from Radford to Indian Village is being built.

TROY, N. Y.—Good progress is being made upon the construction of the electric railway between Troy and Schenectady.

MAYFIELD, KY.—The building of an electric railway from Paducah to Mayfield and probably to Fulton is being agitated.

NASHVILLE, TENN.—A company has been organized to build and operate an electric railway from Nashville to Monte Sano.

IOWA CITY, IOWA—Messrs. Henry Bennett and J. W. Conn are interested in the building of a line from Cedar Rapids to Iowa City.

BRISTOL, PA.—A large force of men is engaged in the construction of the extension of the trolley line from Croyden to Bristol.

NEWARK, N. J.—The Wilmington & Newark Electric Railway Company has begun the erection of its line from Newport to Newark.

KNOX, IND.—News comes that an electric railway is to be built from Knox to Winanac. It is to be both a freight and passenger road.

SOUTH DEERFIELD, MASS.—Engineers E. C. and E. E. Davis have begun the survey for an electric line from Hatfield to South Deerfield.

CINCINNATI, OHIO—It is said that Mr. C. C. Bragg will, provided a franchise is granted, build a street railway line through South Norwood.

SOUTH MCALESTER, TEX.—Messrs. Robert H. Cornell, Charles Hewitt and R. W. Wortham have received a franchise to construct an electric street railway in South McAlester.

MILWAUKEE, WIS.—A quarterly dividend of one and one-half per cent on its preferred stock has been declared by the Milwaukee Electric Railway and Light Company.

NATCHEZ, MISS.—The contract for the iron and also for a part of the rest of the material for the Natchez Electric Street Railway has been let.

EAST ST. LOUIS, ILL.—The right of way for the electric line from East St. Louis to the Mammoth Cave has been secured and incorporation papers are soon to be taken out.

COLONIE, N. Y.—The highway commissioners have given their consent to the Schenectady Railway Company to construct and operate a double track through Colonie.

NEWTOWN, PA.—The Newtown & Yardley Electric Railway Company has received a charter to construct a line between Newtown and Yardley, a distance of six miles.

ROCHESTER, N. Y.—Those interested in the Rochester & Eastern Electric Railway state that work will be begun within a few days on the section between Rochester and Pittsford.

RUTLAND, VT.—The Rutland Street Railway Company has purchased the charter of the Rutland & Woodstock Railway. Mr. Rockwood Barrett is president of the new company.

HARTFORD, CT.—Good progress has been made in the work upon the new power-house of the Connecticut Railway and Lighting Company. In a short time the structure will be ready for occupancy.

BROCKVILLE, ONTARIO—Surveyors are engaged in laying out a route for a new electric railway between Toronto and Brockville. It is said that the new line will also extend to Altoona and Cornwall.

BUFFALO, N. Y.—It is said that the directors of the Buffalo, East Otto & Cattaraugus Electric Railway Company have decided to let the contract for the building of the line to a New York contractor for about $1,000,000.

MARINETTE, WIS.—Surveyors have begun laying out the right of way for the Interurban line between Marinette and Peshtigo, which the Marinette Street Railway is preparing to build. It is estimated that it will cost $75,000.

WILMINGTON, N. C.—The Wilmington Street Railway Company, including the franchises, privileges, trolley lines, power-house, cars and all other properties of the company, has been sold to Messrs. Hugh MacRae & Company.

CEDAR RAPIDS, IOWA—An electric railway is to run from Cedar Rapids to Iowa City. Colonel William G. Dows and Mr. Isaac B. Smith, of Cedar Rapids, are interested in the line which, it is expected, will be built during the coming year.

NEWCASTLE, PA.—The Sharon & Newcastle Railway Company has begun the construction of its line from Sharon to Newcastle. For this purpose a loan of $500,000 has been placed with the New York Security and Trust Company.

ROCHESTER, N. Y.—The New York Railway Commission has granted the Rochester & Eastern Rapid Railway permission to build its line from Rochester to Geneva, a distance of forty-five miles.

MINNESOTA CITY, MINN.—It is said that the survey which was made recently between Minnesota City and St. Paul was for an electric line to connect the two cities. It is also stated that the work of construction will be begun next spring.

CEDAR RAPIDS, IOWA—The city council has granted interurban franchises to the Bennett-Conn Company and the Dows-Smith Company. These companies asked franchises to construct electric lines from Cedar Rapids to Iowa City.

AUBURN, N. Y.—The Auburn City Railroad has decided to erect a new power-house which will furnish largely increased facilities. Arrangements are to be made for furnishing power to cars running from Auburn to Syracuse over the Auburn Interurban road.

ROCHESTER, N. Y.—The Rochester & Eastern Rapid Railway Company, which has a capital of $500,000, has been granted permission by the state board of railway commissioners to construct and operate an electric railway line between Rochester and Geneva.

KNOXVILLE, TENN.—The county court has granted rights of way and an electric railway franchise to Mr. Ashley S. Johnson, over the roads of Knox County, for the purpose of constructing an electric railway from Knoxville to Sevierville within the next two years.

SPOKANE, WASH.—The Chelan Transportation and Smelting Company, which is now building a smelter on the Columbia River, has secured a forty-year franchise for the construction of an electric railroad from Lake View to the Columbia River, where the smelter is located.

KENSINGTON, MD.—Judge James B. Henderson has appointed Dr. Reuben D. Dietrick and Messrs. William L. Terrell and Robert B. Peters receivers for the Kensington &

Chevy Chase Electric Railway Company. Judge Henderson directed that the road be sold at public auction.

MANSFIELD, OHIO—The work of building the Mansfield, Savannah & Wellington Electric line will be commenced at once. The contract for building the entire line of sixty miles has been let to the International Construction Company. The work is to be finished by October 1, 1902.

ST. PAUL, MINN.—The Twin City Rapid Transit Company has secured the use of the right of way of the Northern Pacific Railroad from Mahtomedi to White Bear. It is expected that an electric line will be in operation between those points in time for summer excursions next year.

CORNWALL, ONTARIO—The Cornwall Electric Street Railway Company is rebuilding the interior of the old mill of the Cornwall Milling Company. New dynamos are being installed with the view to operating the system from this new station. Water turbines will be used to develop the power.

DAYTON, OHIO—Good progress is being made upon the trolley line which is being constructed along the bank of the Miami and Erie Canal for the purpose of propelling boats. It is expected that this improvement will increase the value of the canal property and will cause it to be much more extensively used for transporting freight.

SAGINAW, MICH.—The Flint, Saginaw & Bay City Railway Company has been organized for the purpose of building an interurban electric railway between Flint, Saginaw and Bay City. Mr. Robert Oakman, who was formerly state tax commissioner, is secretary of the new company. It is said that most of the right of way has been secured and that the work of construction will soon be begun.

## LEGAL NOTES

LAWYER EMPLOYED ON A YEARLY SALARY NOT A LABORER—A lawyer employed by a railroad company on a yearly salary payable monthly is held, in Latta *vs.* Lonsdale (C. C. App. 8th C.) 52 L. R. A. 479, not to be a laborer or employé within the meaning of those terms in a statute giving a preference to the payment of wages or salaries of such persons out of the assets of insolvent corporations.

FAILURE TO COMPLY WITH CONSIDERATION OF GRANT OF RAILROAD RIGHT OF WAY FORFEITS ITS TITLE—A condition forming the consideration of the grant of a railroad right of way, that a depot shall be maintained on the land, is held, in Lyman *vs.* Suburban R. Co. (Ill.) 52 L. R. A. 645, not to be void because contrary to public policy, but failure to comply with it will forfeit the title of the railroad company.

LOAN OF MONEY TO MAKE IMPROVEMENTS NOT PRIORITY OVER STREET RAILROAD MORTGAGE—In Illinois Trust & Sav. Bank *vs.* Doud (C. C. A. 7th C.) 52 L. R. A. 481, no priority over a street railroad mortgage is held to be created by a loan of money to make substantial improvements to its plant and power, when this was not indispensable to the continuation of the company as a going concern, but was necessary to enable it to maintain the volume of its business.

FAILURE TO REMOVE DANGEROUS WIRES FROM STREET PROMPTLY A MATTER FOR JURY TO CONSIDER—The want of a sufficient force promptly to remove broken, dangerous electric wires from the street, when they have been broken in many places by an unusual storm, is held, in Boyd *vs.* Portland General Electric Co. (Or.) 52 L. R. A. 509, to be a matter for the consideration of the jury on the question of reasonable care, and the court is held to have no right to say that as matter of law it constitutes no excuse for the delay.

## PERSONAL MENTION

MR. ROBERT HAMMOND, the well-known English electric railway engineer, is now in the United States.

MR. C. A. COFFIN, president of the General Electric Company, has just returned from Europe, where he has been for about six weeks.

PROFESSOR W. E. EBAUGH, A. B. (Penn.), Ph. D. (Penn.), has accepted the professorship of chemistry and physics in Kenyon College, Gambier, Ohio.

MR. SIDNEY H. SHORT, who is engaged with the English Electric Manufacturing Company, of Preston, Lancashire, England, is now in the United States.

MR. J. B. HANNA, who was formerly secretary of the Cleveland City Railway Company, will, it is stated, be the president of the Central Illinois Traction Company.

DR. HERMANN SIMON, teacher in physics at Frankfort, A. M., has been appointed associate professor of physics and electricity in the University at Göttingen.

MR. C. W. ROSE, of Coopers, N. Y., has gone to Charleston, S. C., to assist in the erection of a large electric plant, said to be under the supervision of Mr. Thomas A. Edison.

DR. ERNST NEUMANN, teacher of applied mathematics and physics in the University of Halle, has been appointed to an associate professorship in the University at Breslau.

MR. H. A. JONES has resigned as general manager of the Massachusetts Telephone and Telegraph Company to become the general manager of the American Electrolytic Company.

MR. R. E. PEAKE, who is connected with the firm of Clark, Ford & Taylor, which has the contract for the construction of the cable between Vancouver and Australia, has sailed on the Celtic.

PRESIDENT SANDERSON, of the Electric Vehicle Transportation Company, states that the company expects to have four electric stages running on Fifth avenue, New York, within a short time.

MR. W. D. GOSSE, of Toronto, Canada, has been in Knoxville, Tenn. Mr. Gosse represents the Canadian capitalists who are interested in financing the electric railroad between Knoxville and Sevierville.

MR. JAMES T. MORSE has been elected to fill the vacancy caused by the resignation of Mr. Henry R. Wilson from the directorship of the Erie Telephone and Telegraph Company at a meeting of the directors.

MR. R. S. GOFF, of Boston, Mass., who is the general manager of the Old Colony Street Railway Company, has been in Atlanta, Ga., examining the street railway property of the Atlanta Railway and Power Company.

MESSRS. CHARLES A. CASE AND H. M. JONES, representatives of the American Telephone and Telegraph Company, who have been in York, Pa., looking after the interests of the company, have gone to Springfield, Mass.

MR. J. W. JARVIS, president of the Springfield Consolidated Railway Company, in Springfield, Ill., has been in Louisville, Ky., looking after the installation of the new machinery which is being placed in the power plant there.

MR. F. A. W. LEWIN has arrived in Jacksonville, Fla., and assumed charge of the construction for the Pennsylvania Telephone Company. Mr. Lewin formerly held the same position with the United States Telephone Company.

MR. ALLEN H. CRAM, of Macon, who is the general manager of the construction department of the Central Union Telephone Company, has arrived in Mattoon, Ill. Mr. Cram will begin work at once on the new lines to be erected from Mattoon to Windsor.

EX-SENATOR C. C. KAUFFMAN has purchased the Columbia Electric Light and Power Company, in Columbia, Pa. This company supplies electric light to the city. Mr. Kauffmann has resold the property to the Lancaster County Railway and Light Company.

MR. J. S. HEALY, of Cleveland, Ohio, has been in Bath, N. Y., looking after the interests of the Interocean Telephone Company. This company has completed arrangements to extend its lines from Hornellsville to Bath, using the lines of the Independent farmers' line.

MR. C. H. LAWRENCE, of Detroit, who is the general manager of the International Construction Company, is in Mansfield, Ohio, looking after the construction of the Mansfield, Savannah & Wellington Electric Railway, for which the International company has the contract.

MR. J. D. HOUSEMAN, manager of the St. Louis & St. Charles Electric Railway Company, has purchased the incandescent electric light plant in St. Charles, Mo., from Mr. A. D. Williams. Mr. Houseman will operate it in connection with the power-house of the electric railway.

MR. HERBERT LLOYD, who was formerly vice-president of the Electric Storage Battery Company, has been elected to the presidency in place of Mr. George H. Day, who resigned. Mr. George D. Widener, who was formerly second vice-president, has now been made first vice-president.

MR. H. K. PAINE, who represents Stone & Webster, of Boston, and who spent the past winter in Houston, Tex., looking after the street railway interests of that firm there, has returned to Houston from El Paso, where he has been engaged in the organization of the El Paso Electric Railway Company.

GENERAL GREELEY, the chief of the United States Signal Office, has arrived in London from the Philippine Islands, where he has been inspecting the army and navy telegraphs and cables. General Greeley is said to be satisfied with the efficiency of the 6,000 miles of cable and telegraph lines now working in the Philippine Islands.

## AUTOMOBILE NOTES

GOOD RUN BY AUTOMOBILE—The Toledo carriage of the American Bicycle Company, which recently made the trip from Toledo to Rochester, made a good record, practically no repairs being necessary on the route. When the rough roads over which the automobile was compelled to travel are considered, the result is very gratifying to the company.

AUTOMOBILE CLUB OF AMERICA—The club nights of this club were resumed on Tuesday evening, October 22, and will be continued every Tuesday thereafter until further notice. A spread will be served each Tuesday evening. It has been suggested that the members of the club make a point of being at the club from four to six o'clock on Sunday afternoons.

AUTOMOBILE RACE MEETING—The Long Island Automobile Club has completed the arrangements for the motor race meeting on November 16, and has decided on the classifications of the vehicles. Gasoline carriages are divided into three classes: One under 1,000 pounds, one over 1,000 and under 2,000 pounds, and one over 2,000 pounds. Steam vehicles of all kinds are grouped to compete in one class, while electric vehicles of all kinds are grouped in and will compete in another class.

## ELECTRICAL SECURITIES

The movement of electrical securities for the past week may be said, if one is permitted to use an Irish expression, to have consisted of standing still. The principal feature of interest about the stock market in general is the apparent entire lack of public interest in it. There seems to be a disposition on the part both of speculators and the public generally to regard the present as a sort of flood-tide or high-water mark in the general movement of the market, and while the prices of all classes of securities remain high there is little trading done in them and the quotations remain stationary. By some this is regarded as an indication that we have reached the crest of the wave of good times, but in view of the increasing exports of the country, the satisfactory condition of its internal and external affairs, the continual conquest of new market territory by our export houses and manufacturers, this view seems hardly to be justified. Perhaps it is wiser to think that the market has run a little ahead of the conditions which have caused its long continued advance and is simply resting, waiting for the general advance of business to catch up with its advance position. Below will be found quotations of the electrical securities for the past week at the various centres of their activity.

ELECTRICAL SECURITIES FOR WEEK ENDING NOVEMBER 2.

| *New York:* | Closing. |
|---|---|
| Brooklyn R. T. | 63¼ |
| Con. Gas | 214¼ |
| Gen. Elec. | 258¾ |
| Man. El. | 123⅞ |
| Met. St. Ry. | 155 |
| Kings Co. Elec. | 185 |
| N. Y. & N. J. Tel. Co. | 166 |
| Telep., Tel. & Cbl. Co. | 6 |

| *Boston, November 2:* | Closing. |
|---|---|
| Am. Telep. & Tel. | 158 |
| Erie Tel. | 21 |
| New Eng. Tel. | 132½ |
| Mass. Elec. pf. | 94⅛ |
| Westing. Mfg. pf. | 78 |
| Edison Elec. | 245 |

| *Philadelphia, November 2:* | Closing. |
|---|---|
| Elec. Co. of America | 6⅝ |
| Philadelphia Elec. | 5⅛ |
| Union Traction | 28¾ |
| United G. I. Co. | 112 |
| Elec. Stor. Bat. c. | ——— |
| Elec. Stor. Bat. pf. | ——— |

| *Chicago, November 2:* | Closing. |
|---|---|
| Chicago Edison Light | 162 |
| Central Union Telephone | 82 |
| Chicago Telep. | 250 |
| Un. Trac. | 17 |
| Un. Trac. pf. | 54 |
| Metropolitan El. | 90 |

## MISCELLANEOUS

MR. GEORGE A. ZELLER, of St. Louis, Mo., who is engaged in book selling and publishing there, is putting on the market Stromberg's "Steam Users Guide," which has been revised and greatly enlarged. This guide should be of use to those who have steam engines and electrical apparatus in charge.

THE CHICAGO TELEPHONE SUPPLY COMPANY, of Chicago, Ill., has designed the Chicago lightning arrester and distributing board to offer both fuse and carbon protection. Each fuse is mounted in a glass tube and thus has an air-gap surrounding it for its full length. Its universal switchboard is said to be electrically efficient and mechanically durable.

## OBITUARY NOTICES

M. R. KÖNIG, of Paris, who is well know for his scientific instruments and investigations in acoustics, died recently at the age of sixty-nine years.

MR. JOHN WHIPPLE, JR., died recently at Leesburg, Va., where he has been engaged in the electric lighting business. Mr. Whipple was about forty years of age. He leaves a widow.

MR. SAMUEL C. BLACKWELL recently died of paralysis in New York at the age of seventy-eight. For the last twenty years Mr. Blackwell had been treasurer of the Mexican Telegraph Company, with offices in New York. He was born in Bristol, England.

MR. Z. S. HOLBROOK, of Brookline, Mass., has died after a surgical operation. Mr. Holbrook resigned recently as president of the Massachusetts Telephone and Telegraph Company to be president of the American & Moore Electrolytic Company. At one time Mr. Holbrook attended the Yale Theological School, but left the ministry in 1881 to engage in business.

PROFESSOR C. W. SWOOPE, who was the director of the electrical department of the Spring Garden Institute, of Philadelphia, Pa., died on October 7, after a very short illness. In late years Professor Swoope has prepared the column of industrial science notes for the Philadelphia *Ledger*. He was the author of a book entitled "Lessons in Practical Electricity." At the time of his death he was thirty-one years of age.

## NEW INCORPORATIONS

NEW YORK, N. Y.—The Hubbell-Grier Electric Company. $25,000.

GREENSPRING, OHIO—The Greenspring Telephone and Electric Company. $15,000.

COLTON, S. D.—The Colton Telephone Company. $10,000. Incorporators: O. P. Anderson, A. '1. Austin and others.

TRENTON, N. J.—Storey Motor and Electric Company. $500,000. Incorporators: S. Livingston, R. A. Jenks and others.

ARCADE, N. Y.—Wyoming & Cattaraugus Telephone Company. $10,000. Directors: T. Hayden, P. E. Merrill and others.

CUSTER, S. D.—The Rapid Traction Construction Company. $5,000,000. Incorporators: E. W. Farnham, B. R. Noble and others.

EAST ORANGE, N. J.—Missouri & Illinois Railway Company. Capital, $500,000. Incorporators: John B. Sears, W. W. Wood and others.

MONTICELLO, Mo. — Citizens' Telephone Company, of North Missouri. $1,200. Incorporators: Cyrus C. Raine, Charles Little and others.

MINNEAPOLIS, MINN.—Rapid Service Telegraph and Telephone Company. $100,000. It is authorized to build, lease and operate lines in any part of the state.

ALBANY, N. Y.—The Salamanca & Little Valley Railroad Company. $400,000. To operate an electric line from Great Valley to Little Valley, Cattaraugus County.

WADESBORO, N. C.—Bluitt Falls Electric Power Company. $250,000. To dam the Pee Dee River, furnish power and build cotton mills and other factories. Stockholders: I. T. Stowe and others.

LA CROSSE, WIS.—Hillsboro & Northwestern Railway. $50,000. To operate an electric railway between Union Center and Hillsboro, a distance of six miles, and intersect the Northwestern line. Incorporators: L. H. Webster, C. F. Rose and others.

## INDUSTRIAL ITEMS

THE VARLEY DUPLEX MAGNET COMPANY has moved its Chicago office to 82 Lake street. Mr. C. L. Hibbard is the western agent for this company.

THE FEDERAL ELECTRIC COMPANY, of New York, is stated to be in the market for the purchase of a considerable quantity of line material which it intends to ship to China.

THE CHICAGO PNEUMATIC TOOL COMPANY, of Chicago, Ill., received the only gold medal for pneumatic tools and also a silver medal for its exhibit at the Pan-American Exposition, at Buffalo.

THE ELECTRIC APPLIANCE COMPANY, Chicago, desires to call attention to its No. 36 cabinet type wall telephone. This instrument is made in several styles which are described in a circular it is now sending out to the trade.

THE R. M. CORNWALL ELECTRIC COMPANY, of Syracuse, N. Y., is considering the feasibility of increasing its capital stock with the object of becoming a large factor in supplying central New York with all kinds of electric supplies.

THE LORAIN STEEL COMPANY, of Johnstown, Pa., has received the contract to construct an underground electric railway in Wolverhampton, England. The work will be overseen by Engineer W. Milton Brown, who invented the system to be employed.

THE P. & I. COMPANY, of Albany, N. Y., desires to purchase patents on small electrical devices and instruments or the right to manufacture on royalty. This company has a large factory and desires to add to the lines which it is manufacturing at present.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, of Chicago, has just published a new bulletin describing its transmitters and receivers. This is No. 5 of a series of bulletins which the company is issuing. It will be sent to any one interested on request.

THE MORRIS ELECTRIC COMPANY, of New York, is said to have secured a contract for wire and supplies amounting to about $50,000. These supplies are to be used in the extension work which is being carried out by the Mexican Tramways Company, Limited, of the City of Mexico.

THE WATERTOWN ENGINE COMPANY, of Watertown, N. Y., has received the contract for the steam engines for the electric light plant at the Hudson River State Hospital. The order is not large, but it is gratifying because it makes the tenth engine and the ninth installation of Watertown work in state asylums and hospitals.

A. C. NIEMANN & COMPANY, of Milwaukee, Wis., a manufacturer of small dynamos for ignition purposes, is enlarging its present plant, being unable to keep up with its large number of orders. At present the output is twenty machines daily. A descriptive catalogue will be furnished on application to the company.

THE SHELBY STEEL TUBE COMPANY will, after November 1, 1901, consolidate its sales offices in the Empire Building, Pittsburgh, Pa., to which all orders or communications should be addressed. The manufacturing facilities of this company have been steadily augmented and it is now equipped to take care of orders promptly and satisfactorily.

THE CAMBRIA STEEL COMPANY, of Philadelphia, Pa., has issued a new edition of its "Handbook of Useful Information for Engineers." This book contains information relating to structural steel manufactured by the Cambria Steel Company and also tables, rules, data and formula which should be of great use to engineers, architects, builders and mechanics.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., has issued a very elab-

orate and attractive booklet containing photographs of its factories and lists of railways where its air brakes are in use. It contains also photographs of cars and trains on different lines throughout the United States which are equipped with these air brakes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., has published a new price list dated November 1, 1901, which is devoted exclusively to the telephone trade. Telephones, telephone construction, material, telephone parts, batteries and various other supplies are included in this price list. Any one desiring a copy can procure it by applying to the Central Electric Company.

THE WARREN ELECTRIC MANUFACTURING COMPANY, of Sandusky, Ohio, through its western agent, Mr. J. Holt Gates, reports the sale of two 60-kilowatt, 220-volt, 60-cycle, two-phase Warren alternators to the Sanitary District for the drainage canal at Lockport, Ill. The purpose of these dynamos is to heat the various buildings by electricity and to light the offices and buildings by arc and incandescent lights.

THE GOULD STORAGE BATTERY COMPANY, of New York, has issued a very attractive booklet setting forth the features of its storage batteries. In this pamphlet the construction of the plates and the different materials used are described very elaborately. It should be of interest to all electricians who have occasion to install such batteries. The company is prepared to carry out specifications for plants of any size with all accessories.

MANNING, MAXWELL & MOORE, of New York, have issued a very large and elaborately illustrated catalogue of railways, steamship, machinist, factory, mill and electric supplies, which should prove of great interest to all who have occasion to order such supplies. Owing to their large increase in business the company have found it necessary to compile two catalogues. A separate edition for metal and wood-working machinery has been issued.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has issued a new catalogue No. 1,035 from its Edison decorative and miniature lamp department, describing its miniature lamps and appliances. In this catalogue a complete account of all types of candelabra, special series and battery lamps, also telephone, automobile and bicycle lamps, are given. It is said that over 400,000 Edison miniature lamps are now used annually.

THE ELECTRIC MATERIAL COMPANY, of Akron, Ohio, is furnishing samples of a special knob which is to be used with a common wire nail that is said to do away with many of the difficulties now existing in the case of ordinary knobs. It is said that less time is required to place these knobs in position and that the breakage is very small. These knobs are furnished in either porcelain or clay with a special nail for this class of work.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, of Philadelphia, Pa., has taken the agency for the Whitney instruments, and has in stock a full line of the regular sizes. This company also holds agencies for the Bryant Electric Company, Adams-Bagnall Electric Company, Emerson Electric Manufacturing Company, Gardner Electric Drill Company, and other manufacturers of electrical supplies, which shows that this firm is in an excellent position to cater to the interests of the trade.

MR. I. P. FRINK, of New York, has been awarded a silver medal by the authorities of the Pan-American Exposition for the Frink reflectors, which were used for lighting the railway station and Transportation Building. It is said that these reflectors have been awarded a medal in every exhibition in which they have been entered. They are made in many different shapes, sizes and styles for different purposes. A catalogue of these lamps will be furnished to any one by applying to Mr. Frink.

MR. C. E. RICHMONDT, of the Richmondt Electric Wire Conduit Company, Waukegan, Ill., has disposed of his interest in that concern. The company will carry on the business as heretofore. Mr. Richmondt will embark in business in St. Catherine, Ontario, where he will establish tube works for the manufacture of wire conduits. He is also preparing to organize a company for the manufacture of electrical specialties, switchboards, etc. It is expected at the present time that the factories will be ready for business by February, 1902.

MR. GILES S. ALLISON, 57 Broadway, New York city, general sales agent for the Security Self-Recording Register, Valentine & Company, Tripartite Steel Pole Company, Brooklyn Heights Railroad Company and the Lehigh Valley Traction Company, has been distributing among his many friends a very handsome and attractive souvenir picture showing the tall building locality of New York city, the most interesting section of the metropolis. The picture is elaborately finished in colors, surrounded by a white mat and enclosed in a handsomely decorated gilt frame.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is meeting with unusual success with its new type Scheeffer recording wattmeters. The company states that this apparatus has been recently improved, and that it now has a meter which gives an absolutely correct record, is sensitive to the highest degree, and is extremely economical. A pamphlet has been gotten out which fully describes these instruments and gives the prices and full information regarding them. This pamphlet is mailed on application.

THE STANDARD PAINT COMPANY, of New York, manufacturer of the well-known P & B products, has been honored by the authorities of the recent Paris Exposition, having been awarded a special medal for the novelty of its exhibit as well as for the quality of the company's products. This exhibit consisted of a handsome pavilion which was constructed entirely of ruberoid. This pavilion, during the time of the exposition, was occupied by the officers of the Paris customs. This ruberoid pavilion can now be seen at the exhibit of this company at the Pan-American Exposition.

THOMAS H. BIBBER & COMPANY, 37 Arch street, Boston, Mass., are acting as a manufacturers' agency, representing the Granite State Electrical Works, Lisbon, N. H., manufacturer of magnet wires; Cutter Company, Philadelphia, Pa., manufacturer of circuit-breakers; Wire Electric Company, Philadelphia, Pa., manufacturer of rheostats; Adams Construction Company, Buffalo, N. Y., engineers and contractors, builders exclusively of street railways and electric light plants. Mr. Thomas H. Bibber has a wide acquaintance throughout the electrical field, having been connected with several New England electrical houses before the organization of the present company.

MESSRS. F. H. SCHLESINGER AND JAMES A. MEARS have formed a copartnership under the firm name of Schlesinger & Mears, with offices at 220 Broadway, New York. Mr. Schlesinger has severed his connection with the Peru Electric Manufacturing Company, of Peru, Ind. The firm of Schlesinger & Mears will be known as wholesale jobbers of electrical supplies and will make a specialty of all kinds of incandescent lamps, complete lines of sockets, rheostats, receptacles, Sawyer-Man goods, porcelain cleats, insulators, tubes, knobs and all kinds of special porcelains for the trade. Mr. Schlesinger has a wide acquaintance in New York which should be of great assistance in establishing the new business.

NATIONAL-ACME MANUFACTURING COMPANY, of Cleveland, Ohio, announces that it has purchased the entire business together with the patents, good-will, etc., of the Acme Machine Screw Company, of Hartford, Ct. With this purchase all the contracts and obligations of whatever nature now outstanding are assumed. The office and factory are to be located at Cleveland, Ohio, and the Hartford plant will be moved to Cleveland. It is expected that the new factory will be ready for occupancy early in 1902. The business is to be conducted by those who have been engaged in the management of the individual companies. The Acme multiple spindle automatic screw machine, together with a full line of cap screws, set screws and special milled work, is to be manufactured.

THE GEORGE A. WILLIAMS COMPANY, of Jersey City, N. J., has been awarded the contract by the Consumers' Light, Heat and Ice Company, of Newport News, Va., for the installation of a new ice plant, water distilling plant, artesian well, and an addition to its electric lighting plant. The amount of the contract is $145,000. The George A. Williams Company has awarded the boiler contract to the Heine Safety Boiler Company, the engine contract to the Buckeye Engine Company, the contract for Hawley down-draft furnaces to Vice, Whitney & Company, the contract for the electrical apparatus consisting of two 200-kilowatt, two-phase alternators, one twenty-five-kilowatt direct-current dynamo, switchboards, transformers, meters, etc., to the Westinghouse Electric and Manufacturing Company. The ice plant and distilling plant contracts have not yet been given out. Bids for this part of the installation are now being received.

THE GREEN FUEL ECONOMIZER, which has now been installed in a very large percentage of the better class of electric power stations in the United States, is used in the magnificent station of the Narragansett Electric Lighting Company, which is described at length elsewhere in this issue of the ELECTRICAL REVIEW. In this installation the economizer is provided with an electric motor drive for the scrapers which constantly move up and down the vertical pipes comprising the economizer, removing from them all deposits of soot and dirt. One of the reasons which has contributed largely to the success of this form of economizer is this method of keeping the tubes clean so as to utilize the maximum of the heat of the escaping flue gases for heating the entering water to the boilers. In this plant the boiler feed water comes from the economizer at practically the same temperature as that of the body of water in the boilers, and high economy has attended its use.

THE AMERICAN SCHOOL OF CORRESPONDENCE, of Boston, has issued a very neat and attractive handbook describing the courses which it is giving at the present time. This handbook should be of great interest to all who desire to attend a technical school for the purpose of acquiring the practical details of engineering construction. It contains a large amount of valuable data regarding the instruction given in the school, the necessary expenses and the instructors. The electrical engineering course given there is very complete and should be appreciated by all who contemplate making this their life work. There are also courses in mechanical electrical engineering, stationary engineering, marine engineering, locomotive engineering, heating, ventilation and plumbing, textile engineering, mechanical drawing and general courses. Special courses in this institution may also be taken by those who desire a limited knowledge of some subjects. An instruction paper for its courses in heating and ventilation has also been issued by this school. In this paper the various forms of heating and ventilation are described at length. The student in this course is required to work out ordinary practical examples and become familiar with the construction best suited to different places where heaters are required.

## List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED OCTOBER 29, 1901.

685,242 Electric railway; Riccardo Arno and Aristide Caramagna, Turin, Italy.

685,274 Electrolytic decomposing apparatus; Max Haas, Aue, Germany.

685,278 Battery; Gustavos Heidel, St. Louis, Mo.

685,286 Magneto-electric generator; J. S. Mead, Buffalo, N. Y.

685,290 System of armature winding; T. J. Murphy, Montreal, Canada.

685,313 Electricity meter; R. S. White, Chicago, Ill.—In an electricity meter, a rotatable armature influenced by the current to be measured, two commutators for said armature on either side thereof, a roller bearing with which each commutator engages, the bearings acting as collecting devices for the commutators, and end bearings limiting longitudinal movement of the armature.

685,314 Electricity meter; Roger S. White, Chicago, Ill.

685,326 Electric elevator hoisting mechanism; T. W. Eaton, Chicago, Ill.—Consists of a hoisting motor, circuits therefor, movable contacts for controlling said circuits, a rock-arm for actuating each of said contacts, cams for rocking said arms, and means for controlling said cams.

685,393 Electric brake; P. C. Crafts, Boston, Mass.—A winding drum for the brakes of a vehicle mounted on a driven shaft, energizing coils contained in grooves on opposite ends of the

(Continued on page 70.)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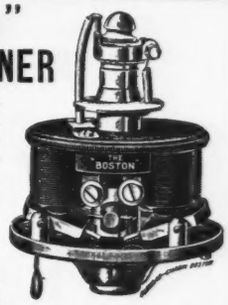

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## PATENTS.

(*Continued from page 69.*)

drum, concentric therewith, and armatures fastened to the shaft so as to rotate therewith.

685,394 Electric brake; P. C. Crafts, Boston, Mass.—A locking device for the brakes of a vehicle, comprising a reciprocating grip-bar, a clamping-shoe thereon, cams for holding the shoe in clamping engagement with the bar, a spring for operating the cams in one direction and a magnet for operating them in the other direction.

685,401 Universal call circuit and apparatus for toll service; A. S. Hibbard, Chicago, Ill.

685,426 Electric arc lamp; John A. Mosher, Chicago, Ill.—In an electric arc headlight, a lamp body having a tubular extension, a frame for carrying the works of the lamp, a bracket to which the frame is removably secured, and a removable cap for the tubular extension.

685,430 Automatic synchronizer; John Pearson, St. Paul, Minn.—A phase responsive device, a switch adapted to be operated thereby, and a time element device adapted to negative such operation.

685,431 Magnetic device for use in alternating-current circuits; John Pearson, St. Paul, Minn.

685,486 Controlling system for electric lamp heaters; Henry N. Potter, Gottingen, Germany.

685,487 Ballast cutout for electric lamps; H. N. Potter, Pittsburgh, Pa.—In an electric lamp of the type shown, the combination with a glower and a ballast therefor, of means actuated by an excessive voltage to divert the glower current from the ballast device.

685,488 Heater cutout for electric lamps; H. N. Potter, Halensee, Germany.

(*Concluded on page 72.*)


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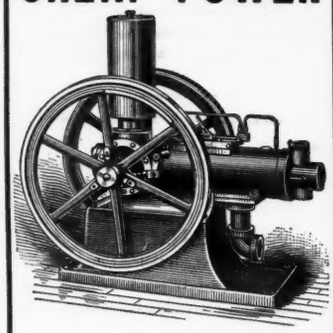

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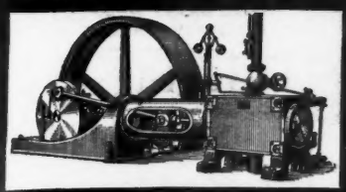

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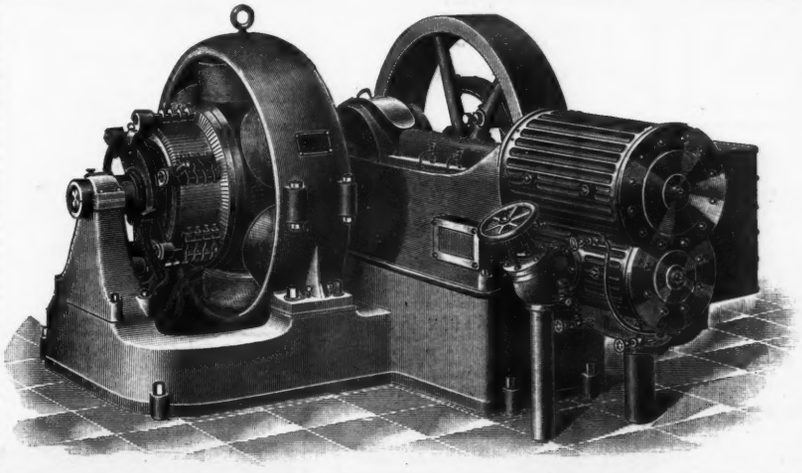

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## PATENTS.

*(Concluded from page 70.)*

685,494 System of electrical distribution; N. W. Storer, Edgewood Park, Pa

685,528 Heating device for electric lamps; Henry N. Potter, Gottingen, Germany.

685,577 Apparatus for regulating electric generating systems; Albert De Dion and Georges Bouton, Puteaux, France.

685,590 Electrical indicator; H. Faltermayer and F. W. Faltermayer, Philadelphia, Pa.—A plurality of magnets and an armature with its free ends curved toward each other, and extending in different planes with respect to the pole-pieces of the magnets.

685 604 Electric switch; J. W. Hearn, Brooklyn, N. Y.

685,715 Secrecy telephone system; F. A. Cumings, Greersville, Ohio.

685,724 Method of electric lighting; W. Nernst, Gottingen, Germany.

685,725 Electric glow-lamp; W. Nernst, Gottingen, Germany—In an electric lamp, a fixed glower, a movable heater, and means actuated by the current traversing said glower for moving the heater with respect to the glower.

685,726 Electric lighting apparatus; W. Nernst, Gottingen, Germany.

685,727 Electric glow-lamp; W. Nernst, Gottingen, Germany.

685,728 Electric glow-lamp; W. Nernst, Gottingen, Germany — A glower for electric lamps, whose body s composed throughout of a mixture of two or more substantially pure oxides of rare earths.

685,731 Ballast device for electric glower lamps; W. Nerust, Gottingen, Germany.


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